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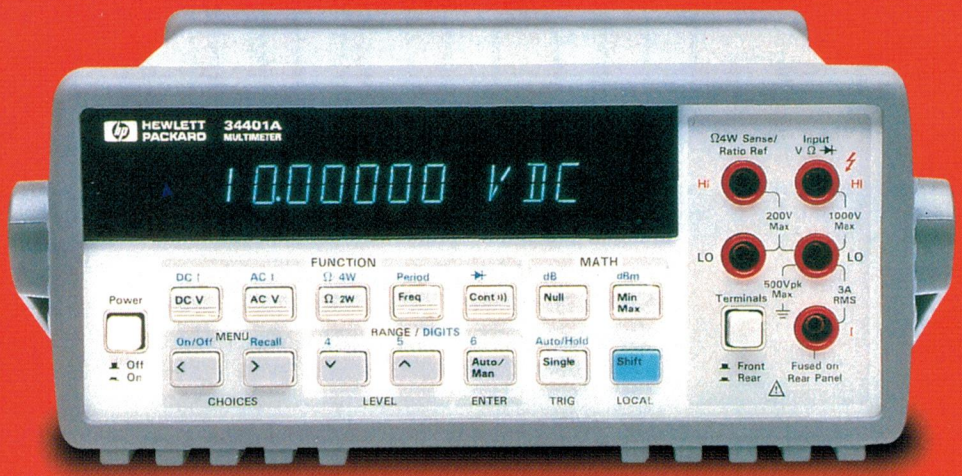

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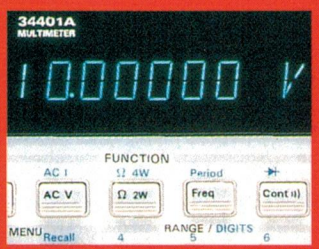

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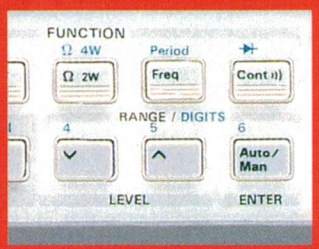

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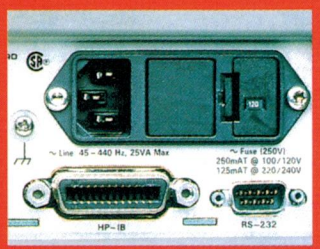

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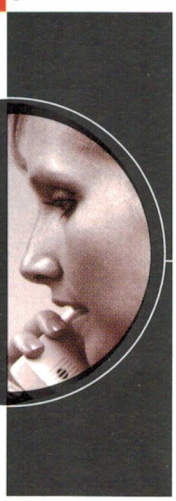

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Electronics

AUSTRALIA with Professional Electronics & ETI

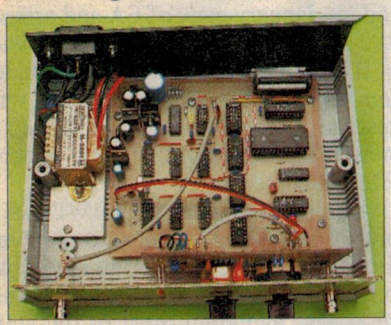
Volume 59, No.3
March 1997

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Epson's digital camera

Tom Moffat has also been evaluating one of the new digital cameras, in this case the Epson PhotoPC 500. You'll see more of the shots he's taken in his review, which starts on page 20. He was also able to e-mail all of the pictures over to us with the text — something you just can't do with prints or transparencies!

Building our Arb Gen...



After a few hiccups, as described last month, our PC-driven Function & Arbitrary Waveform Generator project is finally at the construction stage. You'll find all the details starting on page 62...

On the cover

One of the innovative features of the new Sony STR-DE905G Pro-Logic Surround Sound Receiver is its one-button cordless 'egg' remote control, with inbuilt dual-axis accelerometer sensors. Could it also represent the future for computer mice? See our review, starting on page 10... (Photos by Michael Pugh.)

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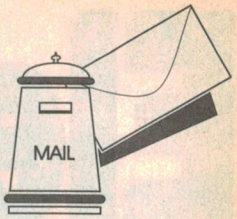
LETTERS TO THE EDITOR



Disappointed librarian

I was most disappointed to see the article in your September issue, 'How to get busted for shoplifting'. Despite the disclaimers and the attempt to dress the whole thing up as a bit of a giggle by the inclusion of cartoon-type illustrations, I believe that publication of this article is an anti-social act that will almost certainly have damaging effects on retailers and libraries.

I cannot speak for the retail trade, but I know that in universities we have a growing number of library users who will ruthlessly steal books, periodicals and other library property. Their motivation is not only to exempt themselves from library regulations re borrowing periods, etc., but also to put their fellow students at a competitive disadvantage by depriving them of access to information that is essential to their studies.

Libraries have spent many thousands of dollars in an effort to protect their collections from this antisocial element, by purchasing the kinds of devices that you describe. You have done no service to either the honest majority of students or to future generations of scholars by disclosing publicly the means by which these protective devices may be circumvented and the libraries' valuable resources may be stolen.

Hans Groenewegen,
Deputy University Librarian
Monash University, Clayton Vic.

I'm sorry you'd prefer we didn't publish certain information about electronics technology, Mr Groenewegen, but many readers have asked for us to explain how that technology works. We were forced to use cartoons because none of the manufacturers would help...

PCB patterns

I wish to point out the lack of standard procedure in printing the artwork for PC boards. Some boards have been shown without the usual corners delineating the extent of the board in relation to the actual tracks, even though the board size is defined in the parts list.

A prime example of this is the PCB patterns for the PC Bus Sleuth on page 60 of *EA* October '96. Opposite the pattern is the warning not to cut the board small as shorts on the 'pins' can cause problems. For most people they expect the complete information with the pattern — not have search the text to find that information. The photographs show that your prototype was correct.

I have bought a kitset from one of your advertisers and the warning was not seen as the PCB in the kit was 2.1mm short; as you can guess it was able to short in the forward position and the backward position. What a shambles, as most computers do not provide a perfect view deep down among the cards.

Would it be possible to set a standard calling for the artwork for PCBs to show the usual corner lines in all cases without fail. I cannot perceive any great problem except to remember the requirement.

R. Ian Henry ZL1BKZ
Auckland, New Zealand.

Point taken, Mr Henry. We'll try harder in future.

BWD still going

I have only just had the free time to read my January copy of EA and noticed in 'The Serviceman' article a reference to BWD oscilloscopes having faded from sight. Some of your readers with these instruments might be interested to know that BWD still lives, but under a different name.

About seven years ago BWD hit a spot of trouble and went into receivership. Mr Bob McPherson and Mr John van de Vreede were able to purchase the assets, including most of the staff, and re-named the firm McVan Instruments. We still attempt to support the old BWD product line but there is, of course, only a limited stock of special spare parts, and very few for instruments over 10 years old. If anybody requires service manuals or spare parts they can ring McVan on (03) 9561 2888, fax us on (03) 9560 1164, or write to us at PO Box 298, Mulgrave North, Vic 3170.

Although the range of BWD equipment is now limited when compared to the 'old days', we still make two models of oscilloscope, along with several meteorological and scientific instruments.

John Miller,
Frankston, Vic.

Windows 95 problems

Having read both Tom Moffat's and Peter Phillips' articles on their troubles with computers, one is left wondering how the 'unwashed masses' cope. I assume that both of these fine gentlemen are well informed on computer matters and have a deep understanding of both the hardware and software. How come they are having so much difficulty? Plug and play; Windows; PCI, etc., were presumably designed to make the computing experience far more simple, for those who think that a 'chip' is something that accompanies fish for dinner. Yet it seems that even the 'experts' are frustrated.

Now I must make a confession. I come from the other camp, the system that was designed from the ground up to run a 'windows' environment and that, up until now, downright discouraged open architectures, foregoing manufacturers of third party product to conform to a 'rigid' set of design parameters.

Recently this manufacturer has opened up the OS and the hardware by licensing its technology, so that PCI, serial ports and the like will become more like its rivals. Am I doomed to the same problems that Tom and Peter are experiencing, or will superior design (both hardware and software) make the computing experience as satisfying as it has been for the last 20 years?

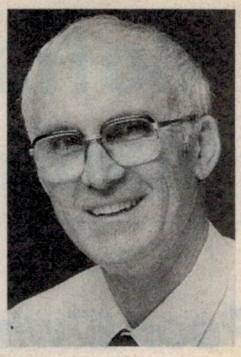
I manage a computing environment that has six computers in Multimedia and Graphics, three in audio and two in video editing, and five in administration. I would have to say that from a technical point of view I can easily manage this many machines (all with quite different hardware and software requirements) with only a few hours a week for regular maintenance and related issues. I'm not evangelising here as to the merits of this particular hardware/software platform, just pointing out that it works!

I am optimistic that, with the advent of the Internet, computing has a chance to 'get it right' in terms of how computers can enhance our working lives and that the problems experienced by Tom and Peter will eventually disappear. But then again I could be completely wrong!

Simon Leadley, Technical Director
Yoram Gross Film Studios,
Camperdown, NSW. ❖

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Pay TV: still not airborne...

There've been a number of stories in the daily press recently about the way Australia's fledgling Pay TV operators have achieved a significantly lower takeup rate than expected — apparently way below the level necessary to cover their heavy setup and programming costs, and show at least a promise of making profits in the near future.

Of concern too, it seems, are their high 'churning rates' — the proportion of people who subscribe for a few months, only to drop off again. The reports I've seen quote churning rates of over 40%, which means that on average two out of every five subscribers are falling away...

This lukewarm subscriber interest is intriguing, when Australians are traditionally among the most enthusiastic adopters of new technology in the developed world. Our rush to acquire cellular phones has been nothing short of phenomenal — so what's the problem with Pay TV?

You don't need to be Einstein to figure it out. For a start, the operators seem to have taken a pretty cynical approach to programme content: heavy emphasis on sport — any kind of sport — and truckloads of old movies and TV series. There are a few later movies and international news services, to be sure, but overall it's scarcely the sort of stuff worth shelling out an extra $40-50 for each month. And while the viewing may not be interrupted by advertising *at present*, most people are aware that this situation will shortly change — leaving very little real difference between Pay and free-to-air services.

Then there's the way at least one of the operators has been stringing its large and relatively unattractive cables down suburban streets, blithely ignoring private objections and public protests. Hardly a successful exercise in good PR...

Considering how much money the operators have invested in hardware and infrastructure, there also seems to have been a surprising lack of effort when it comes to marketing and selling. For example although most of my friends and relatives have commented on the cables strung down their streets, I'm aware of only one who has actually been approached by a sales person. (Yes, they *did* decide to try it — but dropped off after three months!)

Just for the exercise I responded to an advert early last year, before the cable reached our street, expressing potential interest. They duly mailed me a brochure, but the cable has been there now for over six months, and no-one has bothered to follow up the lead...

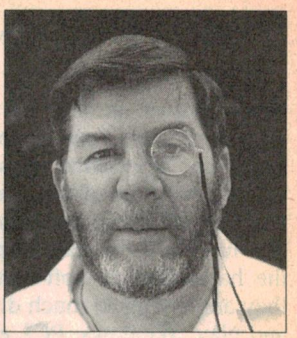
It's a pity that the whole exercise has been tackled in such a half-baked fashion, because the cable operators are surely going to *need* a healthy subscriber base in order to tackle the significant extra cost of the next phase: providing telephony and broadband interactive services.

By the way, our apologies for the thinner issue this month, but it was made necessary by Australia Post regulations. As you can see, it carries the latest catalog from Jaycar — which would have increased the total weight to over 500 grams, if we'd stayed our usual size. The result would have been a dramatic rise in the cost of posting it to our subscribers, and neither Federal Publishing or Jaycar could afford to cover the increase. We'll try to make it up to you in later issues this year.

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



Poor Elwha, the disadvantaged computer

"Windows NT! Windows NT!? Why in the hell does it have to be me?"

Ah, the cry of the frustrated network hacker. Let's try this — (nothing). Let's try that — (Crraassshhhh!). That's life in the dungeon, folks, that big computer room set into the very bowels of the earth here in Port Townsend, Washington.

As many of you faithful readers have heard, I now spend most of my working life in the employ of Olympus.Net, a large Internet Service Provider over here. I'm primarily a tech support and systems guy, but I'm also one who works on what the bosses are now calling 'projects' — plans for the future.

One of our 'projects' is a move into intranets, small computer networks that spin their webs within buildings or whole companies, and in turn can connect with the familiar Internet and thus with the entire world. Our 'Big Mama' Internet facility is made up of a bevy of Unix-based computers, a large collection of industrial-strength modems, a couple of routers to shuffle the data about, and an Ethernet to tie the whole works together.

This kind of setup is fine for a system like ours with a couple of thousand users, but it's truly overkill for an intranet within a company or government department. So a smaller server is called for, and it seems the operating system of choice, where size will never reach gi-normous, is Windows NT. One reason for this is that NT is designed specifically for the IBM-PC platform — and PC's are plentiful, and cheap.

So — *we* are going to become Windows NT specialists to the world. Trouble is, nobody in our whole company has ever even seen NT. Well, then, somebody's just going to have to *learn* NT! Who could that be? How about Tom? He was the first to come to grips with Windows 95... and so the deal was done. Meet your new Windows NT guru-in-training.

I was presented with a large cardboard box, unopened, sent by air freight by our Microsoft friends in Redmond, Washington. Of course, air freight service does not exist between Redmond and Port Townsend, but nobody told Microsoft that. I wonder how much it cost them?

Within the box were two CD-ROM disks — one marked Windows NT Workstation, and the other Windows NT Server. There was also a big pile of books, with one marked 'Start Here'. I decided to start there, with the Workstation version.

We also needed a computer of course, and this brought forth what must be the number-one ugly duckling of the data processing world: an elderly IBM-PC compatible named Elwha. Our ISP business started like most, one computer shoved under a table, a few adventurous subscribers, and lots of luck. That old computer WAS Olympus.Net, doing a job on its own which now requires a whole room full of equipment.

As the system grew, a nice shiny new Hewlett Packard Netserver moved in to replace the old PC as Olympus.Net. The old computer took the name Elwha (all our machines are named after local rivers) and became the HP's assistant, acting as news server and general dogsbody. A few months further on, another custom-built server named Hoh came along and pushed Elwha further toward the unemployment scrapheap. Elwha was relegated to the job of lowly backup machine.

And then one day Tom Moffat came along. Tom had just joined the company and Tom had to learn how to be a Unix hacker, quick. So the boss, named Ned, reached behind Elwha, grabbed a BNC connector, and pulled. Elwha was now offline. Retrenched. Downsized. And Ned said, "Tom, you can do anything you want to Elwha now. Crash it, trash it, do what you will. It can never bring the system down now."

Elwha suffered many indignities, but Tom learned Unix. Eventually Elwha once again got a place of its own, sitting in the bottom of one of the system relay racks. Above it was a shelf for the keyboard, and higher still, a shelf for the monitor. Elwha felt wanted again. So did Tom...

Before long Elwha was allowed back onto the network so users could use Telnet to log into it from home. More Unix experiments went on, now late into the night. But before long, Elwha's job was once again done. Tom was now qualified to work on the REAL computers, and Elwha fell into disuse.

The day I was given Windows NT, I found Elwha standing forlornly in a corner, face to the wall. It had been booted out of the relay rack once again, this time its place taken by a new Sun Workstation. Elwha had been powered down for several weeks, and of course when I tried to get it going again, it wouldn't work. Time to look inside.

Elwha is one of those 'tower' computers of the old school, made of solid steel. Rather nicely made in fact, everything actually fits. But it's as big as a large suitcase standing on end, and it even has little wheels like some suitcases so you can drag it from place to place. One person could never lift Elwha, it weights close to 100kg.

So I horsed Elwha out into the middle of the computer room floor, laid down some newspapers and laid it over on its side with a resounding crash. It was heavier than I thought. But then I could remove the side cabinet door, and all the guts would be accessible from above.

Whooh! What a mess. There were screws and dead memory chips and mouse poop everywhere, all carefully padded by great wads of house dust. "Ned! Better get the vacuum cleaner!" and soon we were ready for the big clean-out. But as soon as I hit the switch, the room filled with dust clouds and Ned ran for the door in a sneezing fit. A true mess. I thought these things were supposed to have filters to keep the dust out...

The filth was so bad I eventually pulled the cards out of all the slots,

pushed some metal brackets aside, and let the vacuum cleaner take its head. Later I gave the slots, and the boards, some liberal shots of contact cleaner — which sent Ned running for air once again. But, before long, we had us a working computer. Well, sort of.

In a subsequent announcement about the Windows NT project, Ned described Elwha's nature as 'cantankerous'. Well said, Ned. Elwha had an 'upgraded' motherboard (in other words, one totally different from the one described in the instructions), it had two hard disks, each of four gigabytes (from different manufacturers), two floppies, a CD-ROM drive and a tape backup unit. Most of which didn't work.

With an enormous amount of fiddling, sans instructions, most of the stuff came to life. Without going into too much detail, the motherboard was of the EISA type in which most configuration is by software instead of DIP switches. The disk drives were driven by a SCSI board, again software controlled. So it was a case of change software configuration, reboot; no good; change again, reboot; try again, over and over.

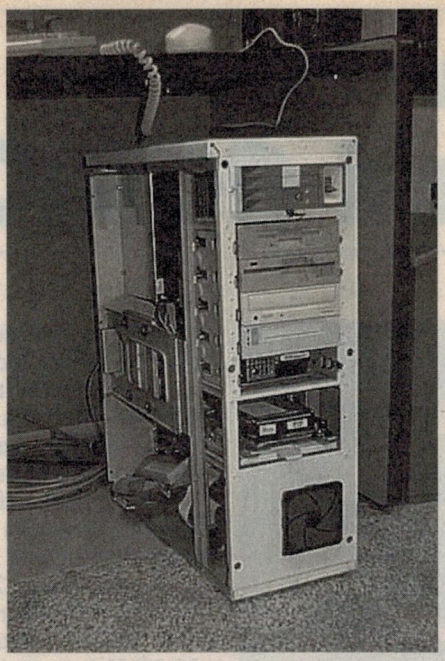
All this hardware hacking eventually reached the stage where a low-level format of the disk drives were necessary (several hours of disk spinning) but after that the various hardware thingos started recognizing each other, and there was a chance the thing would actually run Windows NT.

The 'Start Here' book was organized in a roundabout way. It began with instructions on how to RUN Windows NT, followed by instructions on how to INSTALL it. And the RUN part looked — almost exactly — like a manual for Windows 95. This of course had been Microsoft's goal, to make NT (at least the newest Version 4) look and feel exactly like Windows 95. This gave guys like me confidence: "Sure, I can handle this!" Oh yeah?

Installing something like Windows NT is a real adventure. It is a BIG operating system, and it seems to have loaders that load loaders which then load bits and pieces of Windows NT. You plug a boot disk into the A: floppy drive, slide a CD into the CD-ROM drive, hit reset, and sit back and wait.

From then on disks spin, lights flash, things go click and thump, and from time to time you are asked a question, such as whether to use the MS-DOS file format, or the special one for Windows NT. I decided to accept defaults in all cases, and hope for the best.

So we went through a good half-hour of floppy disk spinning, with occasional



Here's Elwha in all its battered glory. This image was taken with one of the new digital cameras, and comes to you via the Internet.

accesses to the CD-ROM. Things were going very smoothly, and I was beginning to think all those horror stories about Windows NT were simply due to incompetence of the people involved — *they* weren't clever, like me!

Eventually the Windows NT loader announced that its job was done, and it was now going to reboot the computer. Was this OK? Sure, go for it! So the computer booted, and then — stopped. Frozen solid. Nothing to do but hit the reset switch. This got the computer moving, and soon it asked "Would you like to install Windows NT?". We were back to square one...

So I tried again. The whole works, right up to the attempt to reboot. Once again, nothing. So I decided to do a little digging with some MS-DOS diagnostics, and discovered that the hard disk had only a few files on it. And after that it claimed it had zero space available.

Aha! time to reformat the hard disk, for the — third? — time. Now the installer was recommending use of the NT file system, so I let it go ahead. After another half-hour's disk spinning we got to the reboot stage again, and this time the computer came up with what appeared to be a genuine Windows 95 display screen.

Success! Windows NT was working, and it did indeed look like Windows 95. So I spent some play time with our new toy, messing around with things like Paint, just to get the feel of it.

Soon it was time to go for the *real* purpose of the exercise, getting Elwha and Windows NT onto the Internet. Microsoft Internet Explorer was provided on the Windows NT disk for that very purpose, so installation of an Internet connection was soon underway.

It took some head-scratching to figure out that Windows NT didn't have a 'dial-up adapter' for connecting through a modem, as does Windows 95. Instead, NT has 'remote access service', or RAS. So now we know. And RAS almost worked; it got to the stage where it could place a phone call and then log onto Olympus.Net, before being thrown off again for some unknown reason.

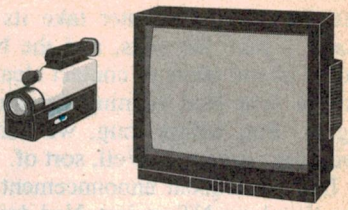
And as we were troubleshooting this, Elwha chucked another wobbly — Windows NT crashed, and then it came back with an announcement that 'Windows NT networking is not installed. Do you wish to install it?'. I said yes, and then NT said it couldn't find the files it needed to install networking. Did *I* know where the files were? No-o-o...

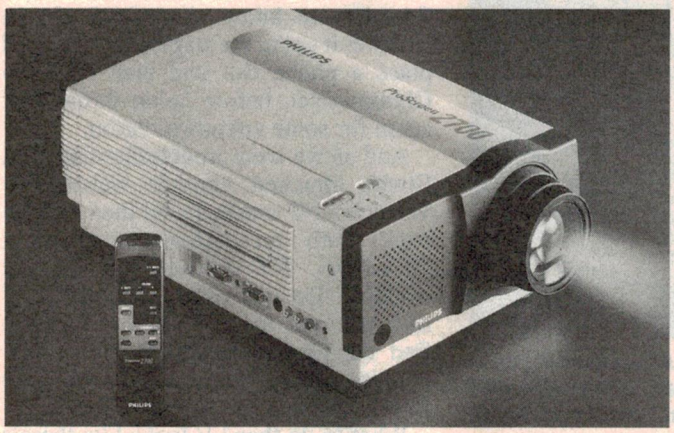
What to do then? It looks like there's no choice — we are going to install Windows NT again, from scratch.

And that's where Elwha sits as this is being written. Crashed, kaput, non-functional, on strike. We're just coming into the Christmas holidays, and that computer is going to have a forced break. Maybe when we come back, some little computer elves will have fixed it, although I'm not holding my breath.

So all this goes to show: Things are never as simple as they seem, despite all the hype about 'user friendly'. Also, the whole affair is a fitting tribute to Mr Murphy and his timeless law: "If Anything Can Go Wrong, It Will". How very true. ❖

What's New In VIDEO and AUDIO





Portable video & multimedia projector

The new ProScreen 2700 is Philips' most powerful, top-of-the-range, portable multimedia projector. It offers professional performance, high luminance, versatility and SVGA scanning rate compatibility, combined with excellent value for money and a high level of user friendliness.

The ProScreen 2700 has a very high light output in its class, measuring 350 ANSI lumens. The optical components are claimed to provide an unprecedented even light distribution over the entire picture surface, delivering a surprisingly balanced brightness. Its 250W metal halide lamp has an impressive 1000-hour lifespan, and it can easily be replaced by the user.

The display elements are three 1.3" polysilicon active-matrix LCD panels, each with a resolution of 640 x 480 pixels — giving a total of 921,600. These are coupled to a zoom lens variable between 50 and 72mm, with aperture varying between f/2.8 and 3.1. The contrast ratio is 150:1.

The Proscreen 2700 supports NTSC (3.58 or 4.43MHz), PAL-N, PAL-M or Secam video (composite of S-video), VGA and SVGA (vertical 59.7 - 85.1Hz, horizontal 15.73 - 39.98kHz), as well as Mac II and Mac LC display video. It also includes a 1.5W mono audio amplifier and has a built-in 3" speaker. The projector can be operated via remote control.

Weighing only 9.5 kilograms, the projector can easily be transported from one presentation location to another — making it very suitable for use by presenters on the move. Examples are public relations experts, consultants and account managers, who have to make a lasting impression on larger groups.

RRP for the ProScreen 2700 is around $9452 including tax. For further information circle 140 on the reader service card or contact Philips Communication & Security Systems, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0464.

Novel bipolar speakers

Claimed as 'a true revolution' in loudspeaker system design, the new BP2000 system from Definitive Technology of Pennsylvania, USA is equally 'at home' as a benchmark hifi speaker or as part of a home theatre system. In fact it has also been specially designed for the new Dolby AC-3 digital surround sound systems.

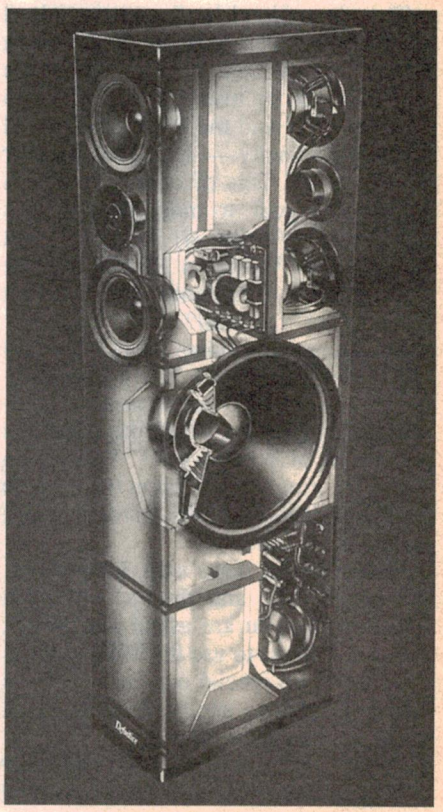
Each speaker system incorporates two complete sets of drivers, one facing forward the other facing to the rear. This novel technology provides the listener with both early-arrival sound information which provides focus, clarity and location data, and delayed late-arrival information which is said to convey the lush three dimensional sound stage of live music or a cinematic performance.

The BP2000's special driver topology is also said to result in a 'panorama of lifelike sound' for virtually every listener in the room, irrespective of where they are sitting.

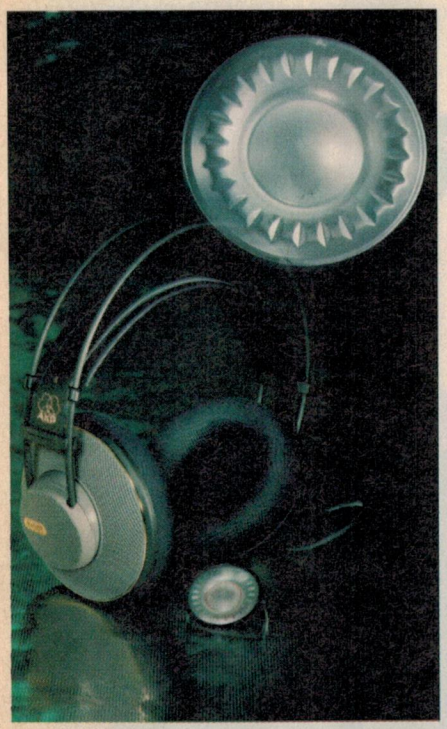
The BP2000 stands almost six feet high, incorporates a total of seven drivers and yet occupies less than one square foot of floor space. Each BP2000 system incorporates four bass/midrange drivers which are arrayed on the front and rear baffles in two concentric pairs, each pair surrounding a tweeter. The front and rear arrays are each enclosed in separate, totally isolated and non-resonant chambers. In addition, the BP2000s incorporate a side-firing 15" 300-watt subwoofer system.

The moving coil dome tweeters developed for the BP2000 are of an aperiodic design incorporating a pure aluminium 25mm dome, acoustically loaded on one side by a precisely configured acoustic phase plug/lens and on the other by a dual-chambered transmission line enclosure. Definitive Technology has balanced the loading on both sides of the dome to assure critically damped, linear movement. The claimed results are smooth frequency response to beyond 30kHz, improved transient response and notably higher definition.

Definitive Technology speakers start from $499 and are covered by a five year warranty on the cabinet and drivers, with three years on the electronics. For further information circle 141 on the reader service card or contact Advance Audio Australia on (02) 9358 6532.



Profiled diaphragm in new AKG stereo phones



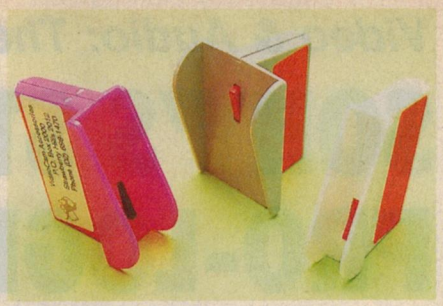
Austria's highly respected audio transducer manufacturer AKG has released a new range of stereo headphones for audiophiles, offering both elegance and improved sonic performance. Pictured is the top of the range model K 501.

A feature of the new models is a diaphragm design called the AKG VARIMOTION SYSTEM, claimed to provide a high-resolution, finely detailed sound with pin-point imaging. The secret is a diaphragm of different thicknesses in different areas. In the 'high-frequency (HF) zone' in the centre, the diaphragm is thicker (80um) for precisely balanced HF response. However within the 'low-frequency (LF) zone' around its perimeter, the diaphragm is much thinner (40um) and thus more compliant — to ensure ultra-precise mid and low frequency response.

In addition the 'surround', a series of corrugations that stabilize the diaphragm, has been redesigned for the K 501 in terms of shape and number of corrugations. This allows excellent control of frequency response. The corrugations in the surround of the K 501 diaphragm are not arranged at an angle as usual, but radially. Their section is trapezoidal and their number has been specifically optimised.

Quality assurance on this type of surround requires a level of acoustic expertise beyond the limits of automated production. Therefore, each pair of K 501 is inspected individually and each diaphragm is hand selected!

Being open-back headphones, the K 501 are airy and well ventilated. They are claimed to combine clear sound and exceptional comfort. In Australia they should be available from all major hifi outlets.



Easier opening of cassette, CD cases

Ever had difficulty opening the package of a new CD, video or audio tape cassette? Some of them can be most frustrating, and it's easy to either break a fingernail or damage the media case if a knife or razorblade are used.

Sydney-based VideoCam Accessories can now provide three very low-cost tools which solve this problem. Called the EZ-CD, EZ-Video and EZ-Cassette, they're small plastic items with moulded-in blades, designed to allow fast and convenient opening of each type of package without damaging either it or yourself. An inbuilt spring loaded blade guard helps prevent accidents when the units are being handled.

Each unit sells for only $4.95, or all three can be obtained for $12 plus $4 package and postage within Australia. For further information contact VideoCam Accessories at PO Box 2000, Strawberry Hills, 2012; phone (02) 9698 1470 or fax (02) 9319 6117.

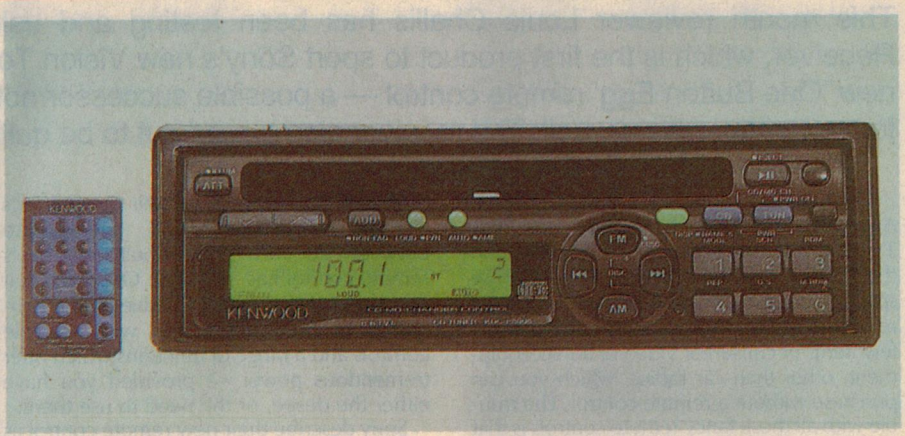
Kenwood's high end CD player/tuner for cars

Kenwood has released what it claims as the best CD Player/Tuner with CD/MD changer control in today's car audio market — the KDC-PS905. It's intended to partner quality car power amplifiers.

As well as the latest technology, the new flagship model offers features normally reserved for top-of-the-line component hifi systems. These include special attention to the output circuity to drive quality amplifiers, advanced 20-bit resolution D/A converters, K-Bus control technology and a completely new CD player mechanism.

The new CD mechanism consist of a vibration-resistant glass epoxy base, which helps protect the circuitry not only from vibration, but also from interference caused by leakage currents on the substrate.

The KDC-PS905's output level is 5V RMS, with a low impedance level of only 90Ω. This means the unit can effortlessly drive connected amplifiers and assure high S/N and wide dynamic range even when there is a long cable running between the components.



The KDC-PS905 also features TDF — a Theft Deterrent Faceplate — reducing the temptation to potential thieves. The strong, yet thin faceplate is simply removed when you leave the car, and slipped into the carry case provided.

Kenwood's Digital Pulse Axis Control (DPAC) provides clean, jitter-free sound, while an array of special low-pass filters known as 'DRIVE' operating between the conventional digital filter and the D/A converter removes quantisation noise from small signals and is said to achieve the equivalent of 20-bit resolution.

Kenwood's KDC-PS905 CD Player/Tuner has an RRP of $999, is covered by a 12-month warranty and available at selected Kenwood car audio dealers. ❖

Video & Audio: The Challis Report

SONY'S STR-DE905G PRO-LOGIC RECEIVER

This month reviewer Louis Challis has been testing and using the new Sony STR-DE905G Receiver, which is the first product to sport Sony's new Vision Touch Technology and its ingenious new 'One Button Egg' remote control — a possible successor not only for multi-button remotes, but for computer mice as well. The receiver also turned out to be quite impressive in its own right, too...

Over the last 10 years more than a million Australian consumers have purchased new TV sets, video recorders and CD players. In the ensuing period, relatively few of those specific products have been sold without remote controls. Indeed, there are relatively few items of consumer video or audio equipment, other than car radios, which you can purchase without a remote control. The trouble with all those fancy remote controls is that they share a common problem with the items over which they exert control — in that with few exceptions, they are becoming more complex, with more buttons and more functions, than most of us either need or desire.

There are a few manufacturers who have recognised the public's disenchantment with the power of remote controls. Sony are one of the elite few who have responded to this obvious fundamental problem. Their response has been to design an innovative remote control for their new 'top-of-the-line' FM stereo and AM receiver.

Unlike the vast bulk of their competitor's remote controls, which incorporate between 20 and 80 pushbuttons, Sony's remote control has 'just one'. Of course that one button relies on interactive video technology to provide the user with multiple controls and a range of functions which offer tremendous power — provided you have either the desire, or the need to use them.

Sony describe their new remote control as a 'One Button Egg' remote control, incorporating a digital gyroscope and employing an RF output in lieu of the more conventional infrared transmission.

The operating principle embodied in the new remote control is simply described as 'Vision Touch Technology'. That is a delightfully innocuous way of describing a system which turns out to be complex in theory as well as in practice.

The first system to make use of the Vision Touch Technology is Sony's new STR-DE905G Pro-Logic Receiver. As I discovered, this receiver provides a relatively potent performance. The two main (front), and centre channels each provide a 120-watt output rating. The two rear channels each have a 50 watt output rating. To access all five channels you have to make use of software that is appropriately encoded with Dolby Pro-Logic sound tracks.

Although no amplifier is provided for a sub-woofer channel, the receiver does provide a dedicated coaxial output for interconnecting an externally powered sub-woofer. Today the sound track of most major films and laser disc videos embodies one or more portions of the sound track which rely on a sub-woofer channel to provide their audible punch and impact.

The receiver also incorporates an excellent and relatively sensitive FM stereo tuner, together with an AM tuner whose bandwidth capabilities and performance are substantially better than most other AM tuners which I've reviewed in recent years.

In keeping with other new receivers, this receiver incorporates audio and video inputs and outputs for laserdisc players, VCRs and TVs. The provision of a video capability of course lead to other less obvious advantages, which Sony has integrated into its Vision Touch Technology. The most potent advantage accruing from such an approach was their ability to transpose the control functions, which you normally find on your conventional remote control, onto the screen of your TV set or video monitor.

If those control functions are provided with an appropriate hierarchical structure, then in theory you should be able to exercise appropriate control over any logical function which is provided electronically by your new item of video or audio equipment.

Now it appears that a group of R&D engineers at Sony's Research Laboratories in Tokyo reviewed the complexity of the remote control problem and opted for what was clearly a revolutionary design concept. The approach that they adopted discarded any thought of hard-wired connections or infrared transmitters. Instead they opted for an RF transmitter as the 'only way to go', supplemented by a single pushbutton controller which functions in an analogous manner to the pushbutton on your computer's mouse.

Actually Sony's engineers have extended the computer mouse concept one step further, in that they've incorporated a pair of accelerometers to provide an 'X-Y' motion detection system. The output of the two accelerometers is fed into a microprocessor, whose output is coupled to a radio frequency transmitter. The radio frequency transmission has a relatively short range, but adequate for it to be detected by a dedicated folded dipole antenna which forms part of the receiver's supplementary hardware. The controller fulfils the same role as your computer mouse does and it moves the pointer on the screen so that you can click the button at the appropriate time to activate specific control functions. Voila!

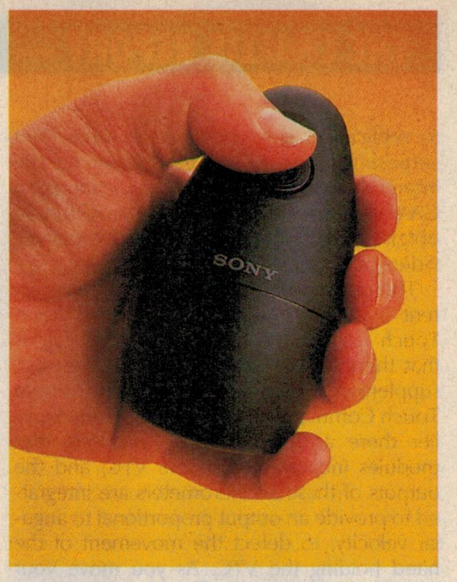
The rear panel of the receiver provides audio and video sockets for four different video circuits. It also provides input audio sockets for a record player, CD player, and provides inputs and outputs for a DAT or MiniDisc recorder, and a conventional cassette or reel-to-reel recorder. On the rear panel input sockets are provided for a coaxial FM antenna, and a pair of spring-loaded sockets for connecting an AM loop antenna, which conveniently clips onto the receiver's rear panel.

The first and most obvious visual benefit of the Vision Touch Technology is the reduction in the number of controls provided on the receiver's front panel. As I discovered, the vast bulk of the normal controls switches are duplicated by the Vision Touch Technology and its on-screen controls, including even those controls for which pushbuttons are provided on the front panel. More significantly, when those controls are activated, confirmation is provided by the visual display.

Immediately below the display are 12 relatively wide individually labelled pushbuttons. These provide a manual input or function selection capability. Two pushbuttons are also provided for selecting the pre-set frequency channels in the AM or FM tuners.

Fortunately a large rotary volume control (which is a must) is provided, as are additional pushbuttons for selecting different choices of sound field from amongst the multiple options provided. These include a conventional Pro Logic mode for decoding programs encoded with Dolby Surround Sound, and an enhanced mode to obtain additional output from the rear speakers, when processing and decoding Dolby Surround. A MOVIE sound field mode with supplementary options of 'small theatre', 'large theatre' or 'Mono-movie' are also provided. Further sound fields are provided for listening to music, including SMALL HALL or LARGE CONCERT HALL modes, as well as the ubiquitous KARAOKE and normal two-channel STEREO modes.

As if that weren't enough, additional DSP sound modes are provided for reproduction of sport, with an ARENA mode offering the characteristics of a large rock and roll concert arena, and a STADIUM mode intended



Above: The business end of Sony's new Vision Touch Technology is this wireless 'one button egg' remote control.

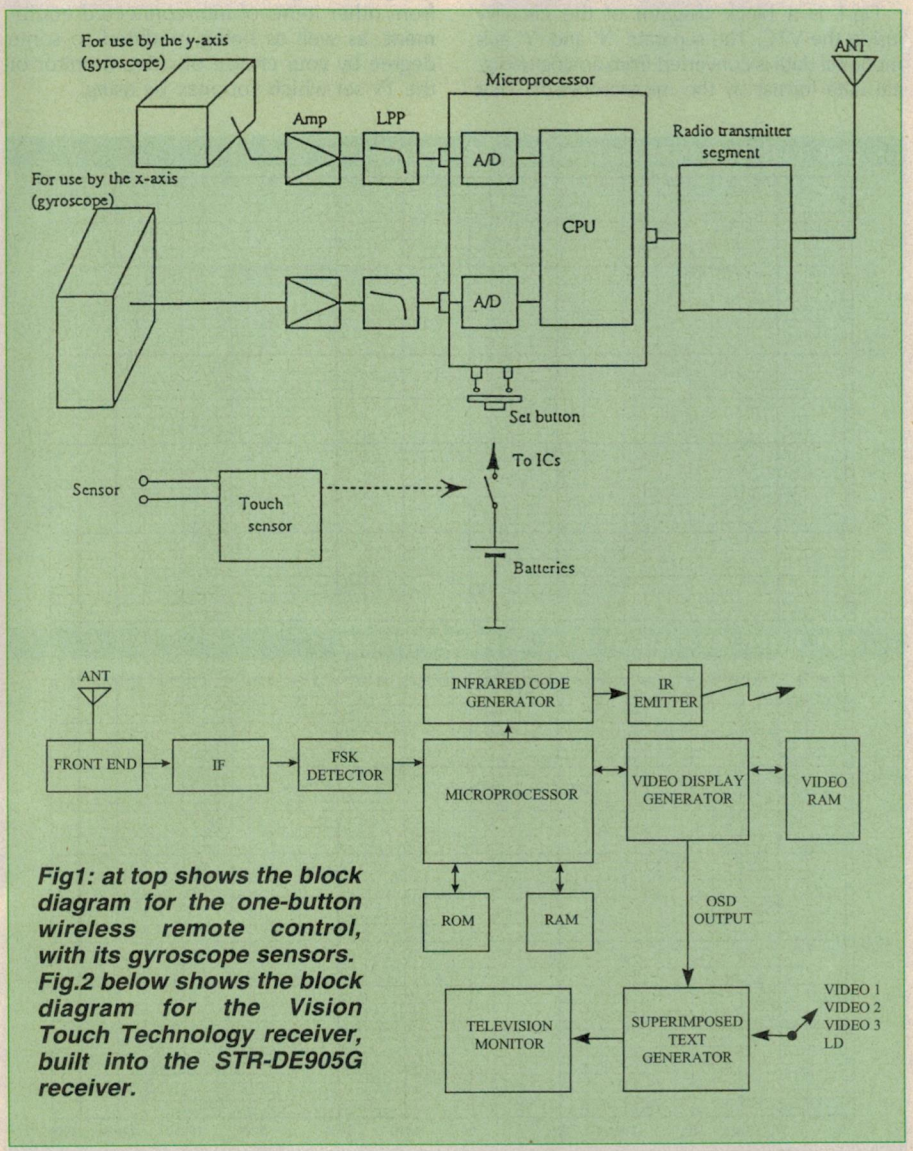


Fig1: at top shows the block diagram for the one-button wireless remote control, with its gyroscope sensors. Fig.2 below shows the block diagram for the Vision Touch Technology receiver, built into the STR-DE905G receiver.

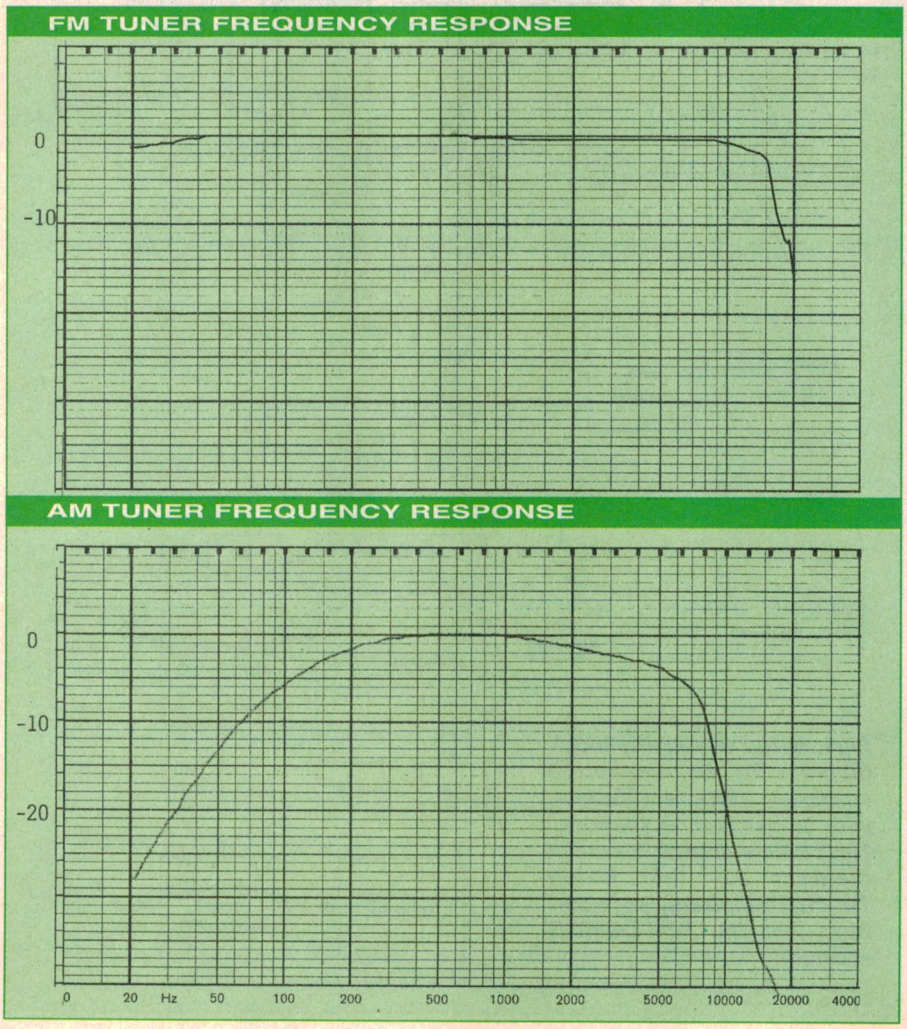
to replicate a large open air stadium. Not surprisingly, and to obviously cater for the interconnection of Sony Play Stations, a GAMES mode has also been provided to obtain maximum impact when replaying video game software.

The primary difference between your current computer's mouse and Sony's 'Vision Touch Commander' or 'One Button Egg' is that there are some innovative and unusual supplementary components in the Vision Touch Commander (VTC). As mentioned earlier there are two separate accelerometer modules incorporated in the VTC, and the outputs of these accelerometers are integrated to provide an output proportional to angular velocity, to detect the movement of the hand holding the VTC. As you move your hand from one side to the other, and/or up and down, these accelerometers (which Sony describes as gyroscopes) generate electrical voltages which are directly proportional to the commander's movement in space.

Fig.1 is a block diagram of the circuitry inside the VTC. The separate 'X' and 'Y' axis motional data is converted from analog to digital data format by the microprocessor. That information is then transmitted in binary format by the radio transmitter, operating as a frequency-shift-keyed (FSK) modulated transmitter on a carrier frequency of 312.5MHz.

The transmitter is designed to allow as many as eight different Vision Touch Commander remotes to be simultaneously used in the same, or adjacent spaces without adverse interaction. An inbuilt sensor in the Commander automatically triggers a signal transmission from the Commander as soon as it is picked up. In its normal stationary position, the internal CMOS circuitry operates in a low current state which typically draws less than 2uA of supply current.

Fig.2 is a block schematic diagram of the receiver and video processor in the Sony stereo receiver. Provided the dedicated detection antenna is correctly positioned on the wall or cabinet in which your equipment is installed, the radio transmitter has a range approaching 10m. The effective reception range is sensitive to interference from other items of interconnected equipment, as well as being modified to some degree by your choice of video monitor or the TV set which you may be using.



The remote control's power supply consists of two AA manganese alkaline cells. These fit neatly inside the convenient egg shaped case and should provide 3-6 months of operational usage.

Using the VTC 'egg'

When you pick up the Commander, the RF transmitter activates from its quiescence state, and transmits a signal which is picked up by the receiver's dedicated dipole antenna. That signal then activates the video display which appears on the TV or video's monitor screen. The initial or Stage 1 entry video display will then be observed. By moving the pointer on the screen so that its position conforms to a button or control symbol, you can activate that function by pushing the remote commander's button.

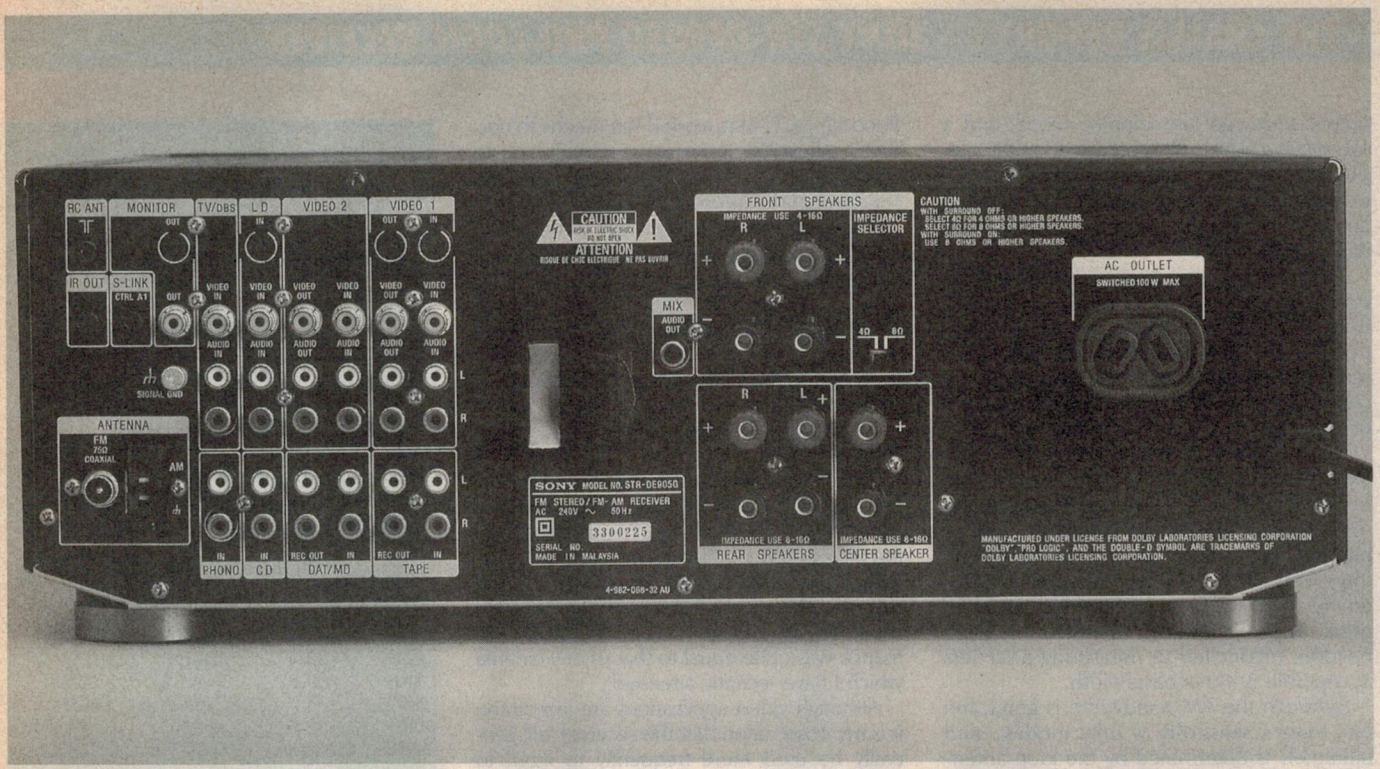
At my first attempt to use the VTC, I experienced some difficulty in achieving a reliable or rapid response in keeping with what I had come to expect from a computer mouse. With a bit of practice, and after I had replaced the small Sony TV set with a more substantial Sony Profeel monitor, this initial hurdle was minimised. The magnitude of the problem was further minimised by correctly adjusting the remote commander's sensitivity using the inbuilt sensitivity adjustment routine, accessed through the set up screen. By adopting a lower level of sensitivity from the range of five settings provided, I was able to exercise a sensible, flexible and repeatable control over the remote commander's pointer response characteristics.

Although I achieved substantial improvements in my ability to control the VTC's on-screen functions, I was still aware of a degree of erratic response and frequent subsequent temporary losses of the on-screen display. This characteristic is considerably more disconcerting for a person who has become reconciled to observing a stable screen display, as typified by a TV set, and video or computer monitor.

The Vision Touch Technology provides a video display signal with a resolution of 256 x 212 pixels. Although that is well below the resolution capability of most computer graphic displays, it is however more than adequate for this specific application.

To ensure that there is a high speed transition between screens and in order to enhance the operational comfort, the hardware memory always contains three screens' worth of data. By avoiding a super-high resolution screen definition, only 128K bytes of video display RAM are needed.

Considerable thought has gone into creating a logical and hierarchical menu system for instructing and directing receiver operation. Thus by way of example, when switching inputs, adjusting volume, or selecting sound fields, there are only two simple steps involved. The first involves moving the pointer to the edge of the screen, and secondly, pressing the button on the appropriate instruction. Having selected the input for a particular com-



As you can see from this rear view, the Sony STR-DE905G provides a full complement of audio and video inputs and outputs. Thanks to the VTT system and 'one-button egg' remote it's all a lot easier to control than you might think.

ponent, the control screen applicable to that component is automatically displayed.

The on-screen display provides access to a fantastic number of subsets of control functions or information. Thus by way of example, you can log in automatic Macro Play sequences for activating and sequentially operating each item of equipment interconnected with the receiver. You can extend the complexity of those macro controls one stage further and set waiting times for sequentially switching various items of equipment ON and OFF. You can also select the type of music you wish to play (after recording the contents of your multi-disc CD player in memory), as well the time of day or night at which you want the equipment to switch itself ON or OFF.

Index codes and settings can be logged for your multi-disc CD player, if you choose to connect one. That information can be further extended to record the name of the disc or the track on the disc. As if that weren't enough, you can even pre-set tone controls (with different settings for different items of equipment or different discs in your CD player).

I was impressed by the receiver's DSP capabilities, which allow you to adjust the delay time between the front and rear speakers, in order to optimally pre-program and correctly decode the Dolby Surround Sound system.

Last but not least, in recognition of the need to control other items of equipment, the vast majority of which are pre-programmed for infrared remote controls, the unit incorporates a slave infrared transmitter. This transmitter can be pre-programmed to send the appropriate control signals for each other item. More importantly, it can be readily pre-programmed to provide the correct signals for other *brands* of equipment, which you may already own and would want to connect to your receiver.

Sounds like fun? Well almost, provided you are prepared to spend at least an hour, and more likely two hours, in active familiarisation with the individual control functions, and developing the skill needed to control the VTC with that single button and the multiple video screen display...

On the instruments

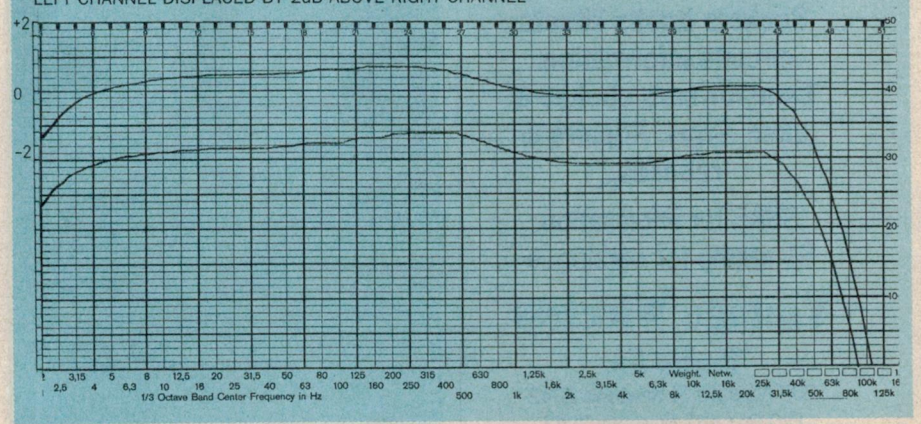
The objective testing of the STR-DE905G receiver's performance parameters proved to be relatively straightforward and gratifying. I discovered that the amplifier's main output channels (front left, front right and centre) cover a broad bandwidth, extending from just under 3Hz up to 43kHz within +/-1dB — almost the same as Sony's published claim.

More significantly, that output response is consistently maintained to the maximum rated output of 120 watts for the three main channels and 50 watts for the rear channels, with all five channels being driven. The 120W rating cannot however be maintained as a continuous sinewave output with all five channels being driven. When attempts are made to maintain that output on a continuous basis, the thermal protection circuit shuts down the receiver's output stages.

If an input is provided from a CD player, a laserdisc player or other input source which causes input stage saturation with the volume control set too low, the output capability of the receiver is less than the receiver's 120W/channel rating. If the receiver input is over-driven with the volume control optimally set, then the

FREQUENCY RESPONSE OF CD PLAYER INPUT

LEFT CHANNEL DISPLACED BY 2dB ABOVE RIGHT CHANNEL



output stages go into clipping mode, and a squarewave signal will be observed at the output. Under such conditions, the recovery is not instantaneous, and may extend for as long as three to four seconds, depending on the severity of the overload.

The frequency response of the FM tuner is also relatively smooth, being within +0/-3dB from 2Hz to 16kHz. The tuner's input sensitivity is 42uV in stereo mode, and 4uV when receiving a mono signal. The signal to noise ratio is better than 70dB in stereo mode and better than 75dB in mono mode.

I was gratified to find that the AM tuner exhibits a somewhat better than average frequency response. The bandwidth at the -6dB point extends from 100Hz to 7kHz. A bandwidth of that order is a very welcome improvement on the performance provided by most other manufacturers, even in their 'top-of-the-line' receivers. I have become reconciled to measuring a far less acceptable 3-4kHz bandwidth.

Although the AM bandwidth is good, the AM tuner's sensitivity is only modest, and ultimately is determined by the loop antenna and its directional relationship to the incoming RF signal.

Overall the receiver's measured performance conforms very closely to the manufacturer's published figures, which I simply couldn't fault. At that point of time, I decided it was time to take the receiver home and subject it to an 'in-depth' residential assessment.

Listening tests

After I set the receiver up in my living room, interconnected an existing Sony CD player, a Pioneer laserdisc player, a Sony Profeel monitor, and a set of five different B&W loudspeakers (without a subwoofer), I was ready to evaluate the system's performance.

I started my evaluation using the 'A Video Standard' laser test disc from Reference Recordings. That provided the means to correctly adjust the 'on-screen' settings and to optimally adjust the positions of the five speakers in my listening room.

The set-up procedure proved to be a trifle longer, and marginally more difficult than I would have expected on the basis of the claims made for the Vision Touch Technology. The main problem was not the adequacy or flexibility of the on-screen controls, so much as the frequent disconcerting temporary loss of video display, whilst involved in performing adjustments, or re-setting specific controls.

With the receiver's controls correctly adjusted, and after the video display had reverted from the Vision Touch Commander mode to the intended video display, the receiver's performance was exemplary. Sony provided two sets of laserdiscs with Dolby Digital encoded sound tracks, and the system's audio performance was quite equal to that of any cinema which I have recently attended.

Although video applications are important, it is my observation that this receiver will generally be used more frequently to listen to CDs, or even audio cassettes. Accordingly I activated the CD player, and auditioned two new Sony discs featuring sopranos.

The first and by far the more renowned is Kathleen Battle, in a new disc entitled 'Angels Glory' (Sony SK 62723). On this disc she is supported by guitarist Christopher Parkening, and the disc is unquestionably outstanding in terms of both content and quality. Although the basic theme is focused on Christmas, the songs and music are seasonless. From the first track right to the 19th, Kathleen Battle held me in rapturous awe of her singing, and the receiver provided exemplary performance.

The second disc which I used was another new disc, 'Jane Eaglen: Bellini, Wagner' (Sony SK 62032). Jane Eaglen is a new and exciting young English soprano whose singing style, and vocal characteristics are radically different to those of Kathleen Battle. Track 3 is a fine rendition of 'Casta Diva' from Bellini's opera *Norma*, and her performance of this particular track is outstanding. As I sat and listened, I was impressed by the performance of the amplifier as much as I was by Ms Eaglen.

As I repacked the receiver into its carton, I had already decided that Sony's RRP of $1399 is not unreasonable when one considers the multi-channel output performance and the exceptional flexibility provided by the new Vision Touch Technology.

Whilst I acknowledge that I was initially critical of what appeared to be a partially erratic behaviour of the VTC, that view changed inexorably as I became reconciled to the system's idiosyncrasies, many of which are intentional design features.

The Sony STR-DE905G receiver is an exciting piece of equipment. It embodies well proven design concepts, supplemented by exciting new technology and features, which Sony will enhance and which I suspect many of its competitors will ultimately copy.

Whilst the development of the Vision Touch Technology may not spell the doom of the ubiquitous remote control (or computer mouse), it must ultimately lead to a new public perception of what is good and what is better.

The dimensions of the STR-DE905G Receiver are 430 x 365 x 160mm (W x D x H), and it weighs 11kg. Further information is available from Sony dealers or direct from Sony Australia, 33-39 Talavera Road, North Ryde NSW 2113; phone (02) 9878 9712. ❖

MEASURED PERFORMANCE

Serial No.3300225

Frequency Response Amplifier Channels
2.5Hz to 43kHz +/-1dB

FM Tuner Sensitivity
Stereo Mode 42uV
Mono Mode 4uV

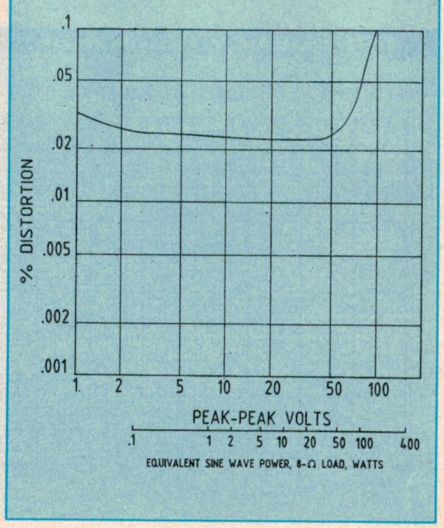
FM Tuner Bandwidth (Stereo Mode)
20Hz to 16kHz +0/-3dB

AM Tuner Bandwidth (Mono Signal)
100Hz to 7kHz +0/-6dB

Harmonic distortion
At rated output of 120W into 8Ω for three main amplified channels (dB):

	100Hz	1kHz	6.3kHz
2nd	-83.4	-66.7	-72.4
3rd	-89.5	-81.3	-72.8
4th	-91.7	-86.0	-74.6
5th	-92.6	-89.5	—
THD	**0.008%**	**0.047%**	**0.038%**

THD vs POWER / MAIN CHANNELS



50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

March 1947

Television — Table Model: The receivers now being developed for Britain's post-war television service will doubtless have a great influence on receiver design in this country, when such a service is inaugurated.

The trend towards simpler and less expensive receivers is illustrated by the Pye table model receiver, which is equipped with a 9-inch direct view tube. The sound channel covers television sound only and there are but two panel controls, picture brilliance and sound volume. The occasional controls — contrast, focus, line and frame controls — are behind a sliding panel under the speaker grille. The price in England is £35, plus £7/17/3 purchase tax.

Radar on the Queen Mary: The development of radar for commercial purposes is well in evidence in the reconditioned Queen Mary, now back on regular service after her long and valued wartime career. The giant vessel is now able to navigate almost entirely by means of radar, even to the extent of docking when it arrives in port.

March 1972

Video discs now in colour: At a recent exhibition in Berlin a full-colour video disc recording was demonstrated by its joint developers AEG Telefunken (West Germany), Decca (UK) and primarily, their jointly owned company, Teldec. Observers generally agreed that the colour quality was excellent and that the picture produced was completely satisfactory for home viewing. The video disc uses a simplified colour system based partially on redundancy of information in the TV picture.

For low-frequency sections of the picture (up to about 1MHz), the colour is line sequential — one line red, one blue, one green, and so on. This information is stored and redistributed on each line.

The discs are about 8in (20.3cm) in diameter. A black and white version, demonstrated in the USA in the latter half of 1970, gave 12 minutes of material. Because of the additional information needed, the playing time of the colour disc is only five minutes. Teldec has also developed a cartridge that can hold up to 30 of the discs, thus giving two hours of playing time or more. The makers plan to market discs for the 625-line PAL and SECAM systems, and for the 525-line NTSC system.

Marketing of the discs and a range of players is expected to start in 1973, with discs expected to sell for the cost of an audio disc. A simple type of player (expected to sell for about $200) will be slot loaded. The disc, in its jacket, is pushed into a slot; after playing it is reloaded into the jacket and automatically ejected. An automatic changer will accept discs loaded in a cartridge. ❖

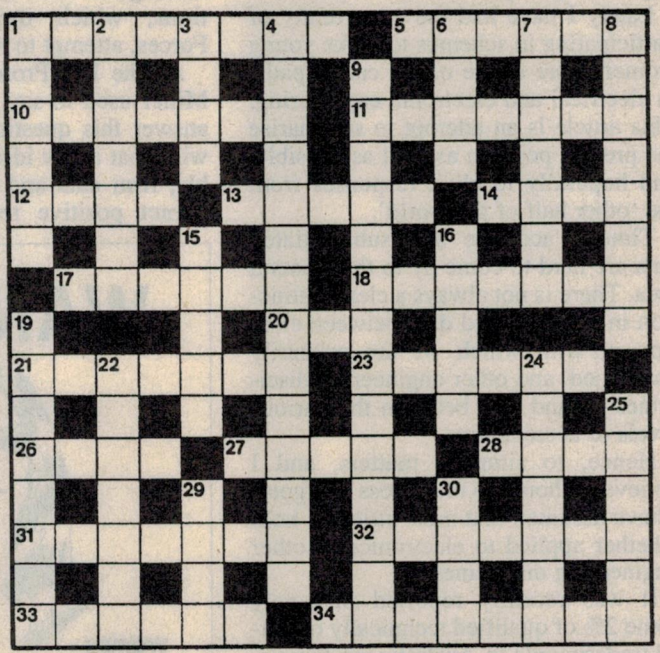
EA CROSSWORD

ACROSS

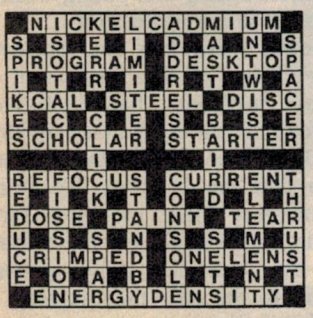
1 Use electric engraving tool. (8)
5 Temporary linkage of radio service. (4-2)
10 Check before normal operation. (7)
11 Naval surface missile introduced in the 80s. (7)
12 Section of a video. (4)
13 Constructor of the first electromagnetic motor. (5)
14 Likely place for an electric fence. (4)
17 Exciting (like any popular LP). (6)
18 Ring-like. (7)
20 Acronym for computer-assisted learning. (3)
21 Astronomical angle. (7)
23 Function of a VCR. (6)
26 Long periods of time. (4)
27 Computer instruction to peripheral. (5)
28 Type of antenna. (4)
31 Capable of fission. (7)
32 Phenomenon observed by certain satellites. (7)
33 Element used in a discharge lamp. (6)
34 Substance produced by battery charging. (8)

DOWN

1 Type of diode. (6)
2 Part of a sound system. (7)
3 An echo sounder can detect this. (4)
4 Adjunct to a mobile phone. (7,7)
6 On line real-time (abbr). (1,1,1,1)
7 One who appears expert in every field. (4-3)
8 Partly shaded area. (8)
9 Heating problem. (7,7)
15 Control on a CRO. (5)
16 Request for admittance. (5)
19 Critical times for aircraft. (4-4)
22 In a charged state. (7)
24 Unresponsive driver. (4-3)
25 Small unit of length. (6)
29 Unmoved, or in .... (4)
30 Filament prone to electrostatic attraction. (4) ❖



SOLUTION TO FEBRUARY 1997:



They're needed to create the 'Clever Country', but

HOW *DO* WE ATTRACT WOMEN INTO ELECTRONICS?

Despite efforts during the past 15 years, Australia still lags most developed countries in attracting female students to study such subjects as electronics and engineering — whether at professional or para-professional level. If Australia is to become a 'clever country' it can ill afford to ignore the talents of one-half of its population in this wealth creating field. This article draws upon a mixture of the author's personal observations in this area, as well as those of others and published data.

by JOHN BELL, B.E., M.Eng.

My own interest in attracting young women to the ranks of the engineering fraternity, and electronics in particular, was triggered by two simultaneous events some years ago. Firstly, working with the Australian Defence Forces, I became aware of the success that they were having in training young women in demanding technical and administrative roles. Secondly my younger daughter was having little success at school in gaining information about science and engineering as possible career paths.

Lately I have had the opportunity of participating in schemes to make young women more aware of the career paths in electrical and electronic engineering. This article is an attempt to summarise the present position as well as possible, and hopefully to elicit responses from the 'other half of the world'.

Timely, accurate and substantiated data are hard to come by in this general area. There is not always a clear distinction in all published data between electronics, with which *we* are primarily concerned, and other engineering disciplines — and also between the various levels of accreditation.

Hence, to simplify matters, and I believe without too much loss of rigour, I have assumed that most attitudes hold whether applied to electronics or other engineering disciplines.

It was recently reported that only some 2% of qualified technically oriented tradespeople in Australia are female. This is surprising, as many authorities claim that girls are beginning to outshine their male counterparts at schools and tertiary training in previously male-dominated areas.

Some one in five computer professionals are now estimated to be female, but their numbers predominate in the corresponding non-professional aspects such as data entry[1]. There seems to be far fewer in the more hands-on aspects of engineering, whether as technicians or as fully fledged professionals.

Those whom I have met have impressed me with their technical ability, normally well above average. What is disturbing is the fact that few such well-educated and capable women are found in significant managerial positions outside traditional areas — although a few enlightened organisations, which include the Defence Forces, attempt to rectify this.

As the late Professor Julius Sumner Miller used to say, "Why is it so?" To answer this question is difficult, but I will float a few ideas and, where possible, firm data and trust that these will attract positive reaction through the columns of this magazine from those best able to supply answers — the girls.

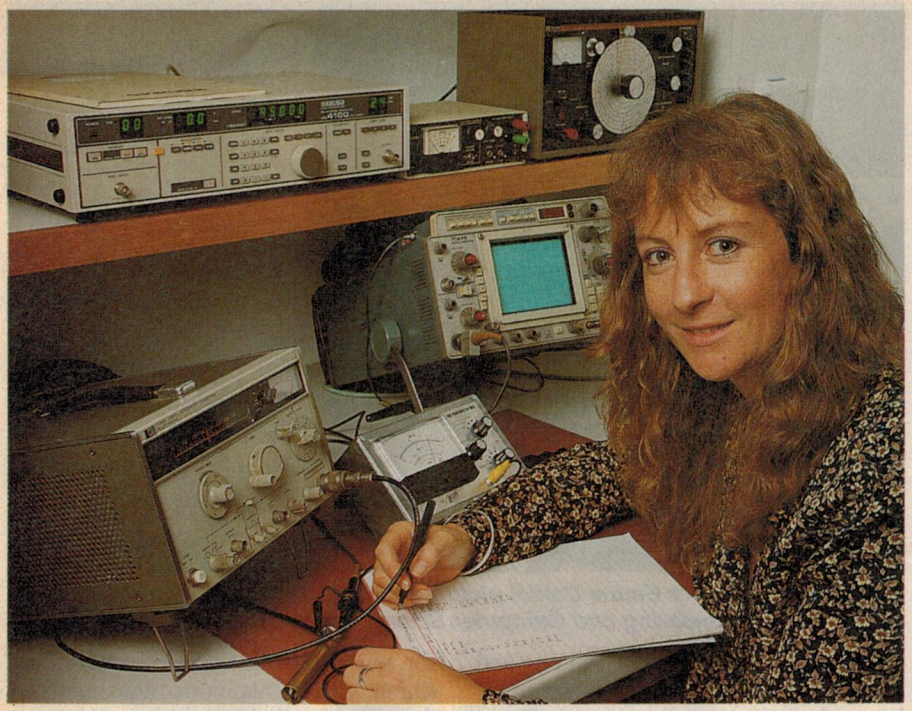
Fig.2: A poster used in 1975 by the Victoria University of Technology, and considered sexist even then.

Although women are gradually making inroads into previously male-dominated professions in Australia, it is interesting to note that engineering is one the courses least likely to be chosen by female students. This contrasts sharply with the eastern European Countries, the US and the UK as presented in Fig.1.

In Australia it has been noted[2] that a high proportion of female students enrolling in engineering undergraduate courses choose *chemical* engineering and it is claimed that this reflects their interest in chemistry, rather than physics in school years 11 and 12. This leaves the electrical and electronics courses under subscribed, so far as female students are concerned. And this, of course, is transcribed into the more hands-on trade courses.

In order to redress this imbalance the Institution of Engineers, Australia set up a number of Women Engineers Groups, commencing in Sydney in 1981. More recently it introduced Engineering 2000 excellence awards, designed to reward and publicise the efforts of women in a number of categories. The Young Engineer of the Year Award was won by Andrea Ryan (a Civil Engineer) in 1995, demonstrating that young women have a future in the profession.

The South Australian and Northern Territory Centre of The Institution of Electrical Engineers has instigated awards for outstanding female students at The Universities of Adelaide, South Australia and the Northern Territory. These, and other similar initiatives, have resulted in a reasonable amount of publicity in the Australian press, alerting the public to the fact that training in electrical and electronic engineering are



very suitable career paths for women.

Schemes have been instituted to attract females into Engineering in general. A women-in-engineering programme was launched in the 1970s by The Victoria University of Technology, but the poster shown in Fig.2 was considered sexist, even at that time. Interestingly enough, the Institution of Electrical Engineers were advised to go through the Equal Opportunities Commissioner in South Australia before the awards for female undergraduates were formalised. Happily, there was encouragement rather than opposition, which reflects some advances in society's thinking.

The Australian Women's Bureau has produced high-quality publicity material aimed at secondary school girls, an important initiative as it is at this stage that most career choices are made. In the UK a 'Women in Science and Engineering' programme, involving a touring bus, has been successful in raising the enrolment rate by 6% in a decade. Similarly, the University of Melbourne has, through its Women in Engineering project, succeeded in raising the participation rate from 6% in 1985 to about 23% today.

Sadly, it has been reported[3] that some of this sort of effort has been diluted in a number of institutions. I hope to hear otherwise, or that it has been replaced by other promotional seminars. The Australian National University has held extremely successful hands-on workshops for girls, demonstrating the broader social context of engineering by careful selection of projects such as solar power.

The Institution of Engineers, Australia is actively promoting its Neighbourhood Engineering Scheme, one major facet of which is to introduce the concept of engineering as a worthwhile career for both sexes in schools. All this effort, diverse as it is, is slowly beginning to bear fruit.

The Defence Forces, the Defence Science and Technology Organisation (DSTO) and defence industry have a generally good record in selecting and training technical personnel of both sexes. I believe this to be true of other major industries, though few women make it to the top rungs[2]. This is probably not a reflection on their ability but the need to balance other family responsibilities against the demands of work. There is also reported opposition to women by a few, largely nontechnical, males.

The author, recently undertaking a refresher course in Computing Studies, has been most impressed at the dedication and aptitude of the women in his classes. Few men there can match the best of them. And no tertiary courses are easy, whether at TAFE or University, with electronics or computer-based subjects being amongst the most demanding.

Although perceptions are slowly changing, within Australia and the UK, it is unfortunate that the general public has little knowledge of the professional duties of technicians and engineers. (My own parents used to think that my electronic design work for aircraft involved my lying underneath an aircraft, saturated with dirty oil and holding a large spanner!)

Daily papers often reinforce the concept of scientific achievement, but engineering failure. There are significant misconceptions about the differing, but complementary, roles of technicians, engineers and tradespeople. There is a general failure to recognise that most engineering successes are a result of a team effort, and that balanced teams are desirable. The public at large is more familiar with the role of health and legal professionals.

Misconceptions include seeing engineering, of which electronics is a significant part, as dirty, perhaps dangerous and requiring brawn rather than brain. Television viewers see rows of white coated girls on assembly lines and operational staff sitting in front of consoles.

Communications and other outside electrical installations are seen to dominate the landscape, perhaps confused with manufacturing and mining which are not always perceived as being environmentally friendly. Myths perpetuated include judgements that engineers are not social animals, dealing with things rather than people, are poor communicators and are inarticulate. Try running any organisation without these skills!

Indeed some of the benefits which young women can bring to the workface include their recognition of the social

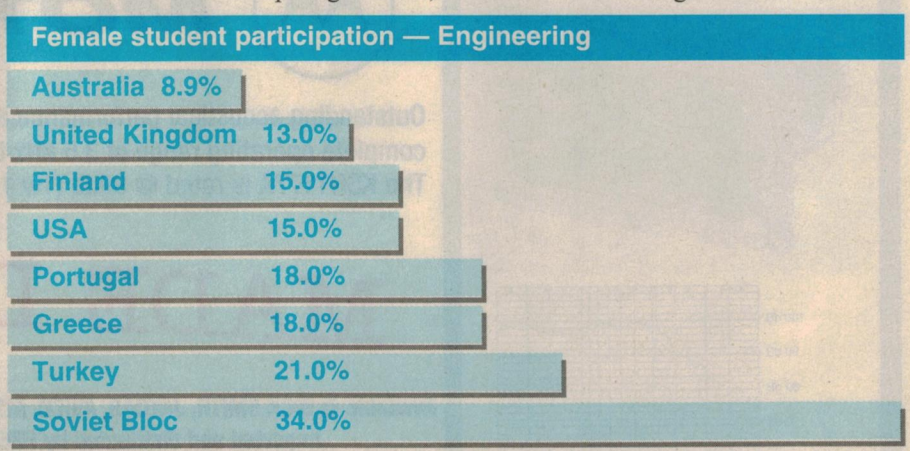


Fig.1: A comparison of estimated female participation rates for engineering in a range of countries in 1990.

content of their work and its relationship to the wider world, as well as their inherent interpersonal and communication skills. They are often acutely aware of dangers to the environment. For them there is a natural connection between the electronic control of a wheelchair and the needs of an incapacitated user.

Few engineers are found in the school sector, which is primarily staffed, in a general sense, by those trained in the humanities and a broad scientific background. Although this is entirely reasonable for the vast majority of students, it will may fail to awaken positive interest in engineering type careers, which may be seen to be of low status compared with Medicine and Law. And Careers Advisers cannot be expected to be 'Jack of all trades'.

What is interesting is that girls entering such careers as electronics are more likely to have attended a single-sex school, or to have had an engineer as a role model in the family or as a close associate.

To attract more young women into electronics engineering, there must be shift in attitudes. Those of us in the profession must take a leading role. People enter professions due to peer pressure, family influence, educational background and achievements — and what they read and see on television.

If Australia is ever to become a Clever Country, it cannot hope to succeed if young women are not attracted to the profession. One cannot just delete one-half of its potentially skilled work force and expect success.

It is hoped that this short article will assist in raising the interest, training and role of women in electronics in particular, and engineering in general. There must be many more initiatives in place, and planned, to promote this cause.

Electronics engineer Emine Daldal pictured in 1990 working in the Department of Electrical Engineering and Computer Science at the University of NSW.

It was pleasing to see some two pages of *The Australian*, well supported by universities, recently devoted to this topic. I trust that as a result many more young women will be attracted to the profession through this type of promotion. Nevertheless, the need for such a promotion, excellent though it was, is symptomatic that this nation still needs to break down such barriers — which apparently still exist in the psyche of much of the population, male and female alike.

Lastly the views expressed above are of the author alone. He does not speak for, nor reflect the views of, any organisation. Comments, corrections and further inputs will be welcome. Come on ladies — have your say!

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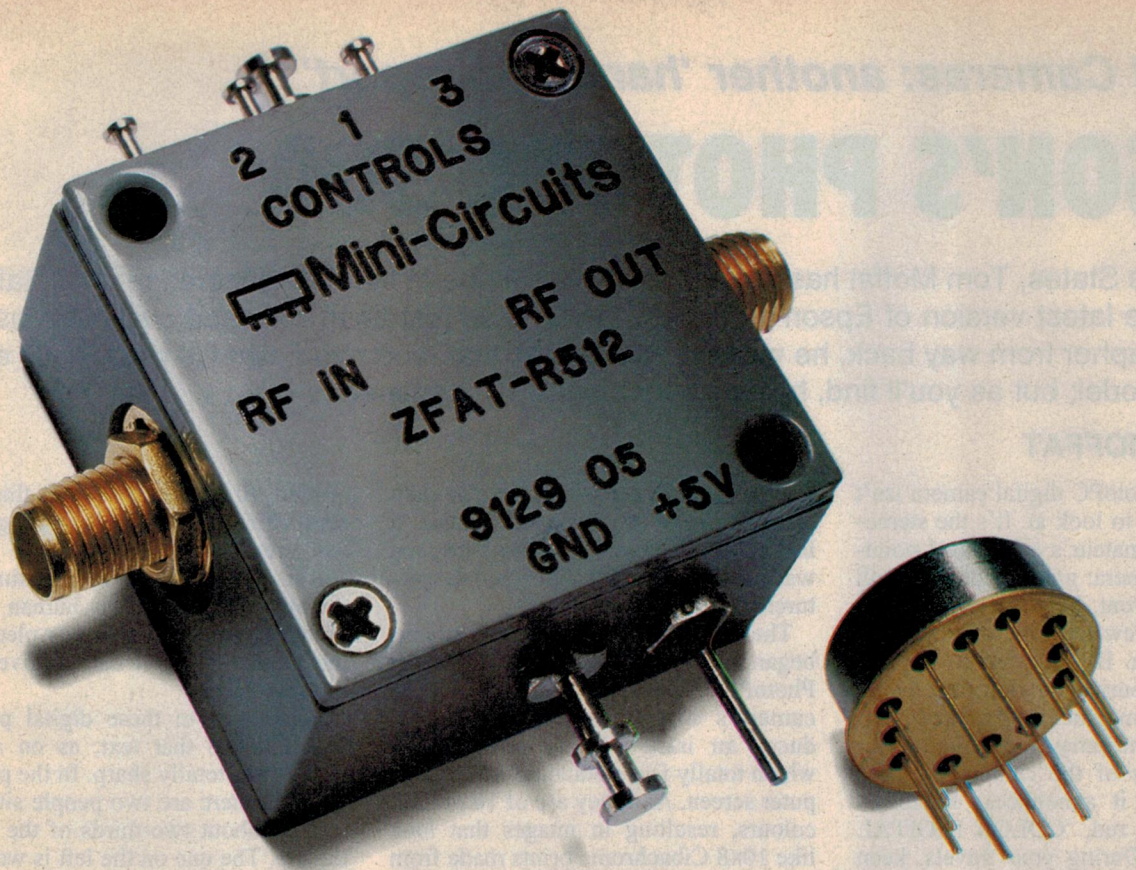

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0.5	**0.12**	**1.0**	**0.2**	**3.0**	**0.3**	**4.0**	**0.3**	**5.0**	**0.3**
1.0	**0.2**	**2.0**	**0.2**	**6.0**	**0.3**	**8.0**	**0.3**	**10.0**	**0.3**
1.5	0.32	3.0	0.4	9.0	0.6	12.0	0.6	15.0	0.6
2.0	**0.2**	**4.0**	**0.3**	**10.0**	**0.3**	**16.0**	**0.5**	**20.0**	**0.4**
2.5	0.32	5.0	0.5	13.0	0.6	20.0	0.8	25.0	0.7
3.0	0.4	6.0	0.5	16.0	0.6	24.0	0.8	30.0	0.7
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READER INFO NO. 5

Digital Cameras: another 'hands on report'

EPSON'S PHOTOPC 500

Over in the States, Tom Moffat has also been trying out one of the new generation of digital cameras — the latest version of Epson's PhotoPC, which has just been released over here as well. A photographer from way back, he wasn't expecting all that much from what is essentially a pretty basic model; but as you'll find, he was very pleasantly surprised...

by TOM MOFFAT

Epson's PhotoPC digital camera isn't all that much to look at. It's the stereotype of the amateur's entry-level point-and-shoot camera: gray in colour, small lens on the front, hole to look through on the back. Few controls, other than the shutter button. If you want to impress your fellow tourists on your next trip to Kakadu, you may be disappointed.

However, the carry-case makes up for the blandness of the camera. In bold white letters it announces 'PhotoPC' and below in red, 'COLOR DIGITAL CAMERA'. During your travels, keen photographers will eye that case and ask "Is that REALLY one of those new digital cameras? What's it like?" And *then* you can skite a bit...

Even more fun is when you get to show the pictures. Recently after a large dinner party there was a crowd of perhaps 10 or 12 people all crowded around the screen of my laptop computer, shrieking with laughter as photos of themselves, taken only moments before, popped up on the screen. Even people who are not computer-savvy are mightily impressed by this performance.

There are actually two Epson PhotoPC's available in Australia as this is being written — the original PhotoPC and the newer PhotoPC 500. The later model stores more pictures, is said to have improved optics, and it has a flash option for 'red-eye reduction' where the flash goes off gently several times to close down your eye irises, before unleashing its full blast. In this discussion we will be talking about the 500 model unless otherwise advised.

Up to now I've been pretty wary of digital cameras. I remember a couple of years ago the Apple Quick-Take digital camera appeared on the market. It was a good gimmick, and it was a first. But the pictures were — well, awful. Then about eight months ago I actually got my hands on an early Casio digital camera, on display in a computer store. It had a little LCD screen on the back, and was pretty impressive, but again the pictures were marginal.

Then the new crop of digital cameras began appearing; among them, Epson's PhotoPC. All I can say is 'wow'. The camera's high-resolution mode produces an image of 640x480 pixels, which totally fills a standard VGA computer screen. And they are of 16 million colours, resulting in images that look like 10x8 Cibachrome prints made from 35mm slides. Since the computer is providing the light, the pictures glow, as if a slide were projected on a screen.

Where the Epson and other digital cameras fall down is in resolution, but this is no big deal. If the digital image is used in its full resolution, every pixel requires three bytes, and at 640x480 pixels that represents nearly a megabyte per picture. So the pictures undergo some fairly severe compression, resulting in a file size in the computer of around 40 or 50KB. To do this much scrunching, something's gotta give, so some resolution is sacrificed.

But subjectively, the pictures are remarkably good. The human eye is pretty forgiving and if it is pleased by the whole scene, it can forgive a few missing details.

Sometimes in these digital pictures, you'll notice that text, as on a street sign, is not totally sharp. In the photo of the rock there are two people sitting on a ledge about two-thirds of the way to the top. The one on the left is wearing a white shirt. On a 640x480 computer screen, you can just make out the people. On the printed page you may not see them. This is pretty much the practical limit of what the PhotoPC can do.

There is a small LED on the back of the PhotoPC near the viewfinder. When the LED is green, the camera is ready to take a picture. As soon as you press the shutter button, the LED turns red and flashes for several seconds. During this time the camera is scanning across the image it's just

Yes, it's originally from Melbourne, but now operates in Seattle, Washington. (Available light only, apart from the light in the drivers compartment.)

An indoor shot taken with the Epson PhotoPC 500. It shows a shopping centre in Victoria, British Columbia (Canada), taken with available light.

stored on its CCD, turning into a JPG compressed image file which it then saves in a 2MB flash memory.

The shutter release is really the only user control. everything else — shutter speed, exposure, flash operation — is fully automatic. This situation is a little worrying to a photographer who has always used professional cameras with full control, but the proof is in the puddin' and the PhotoPC always seems to turn out lovely results under the most trying conditions. The photos with this article were taken indoors, outdoors, with natural light, with flash, in blinding snowstorms and in bright sunlight, close-up and far away. Judge for yourself...

Two picture modes can be selected - high resolution (640x480 pixels) and low resolution (320x240). The 500 version can store 30 hi-res or 60 low-res photos. It is possible to expand the memory so that 100 hi-res or 200 low-res pictures can be stored.

Since flash memory is used, the pictures will be retained indefinitely even if the camera's four AA-cell batteries go totally flat. Four alkaline cells seem to be good for about 200 pictures.

Once a shooting session is over you can download your pictures into the computer, via a supplied serial cable. You can do this after one or two frames are shot, or later when the camera is totally full. Afterwards you can erase the pictures from the camera (like putting in a new roll of film), or you can leave them there and shoot further photos until the camera is full.

Using PHOTO!

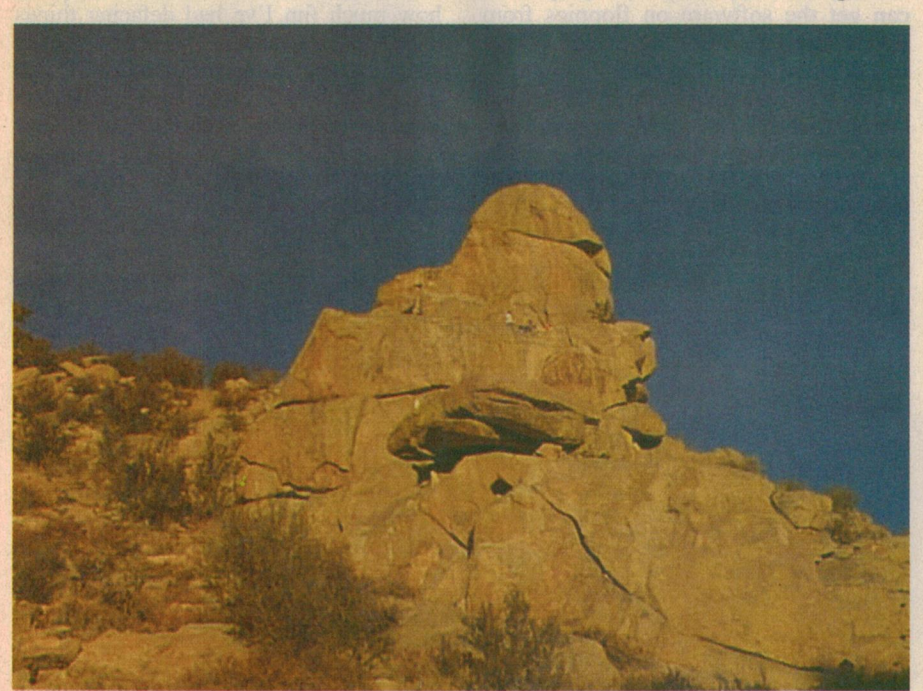
The main picture-handling software application supplied with the Epson is called Photo! (always with the exclamation mark!). Versions are supplied for both IBM-PC and Macintosh. Before running the software you must connect the camera and the computer using the serial cable. The program then detects the camera and you're ready to roll.

The software first downloads small 'thumbnail' versions of each picture, each about the size of a 35mm negative. But they are big enough to see what the photo is, and if it's worth downloading the full version. You can click on the ones you want, or select the whole lot. The software then loads the photos into a directory or folder of your choice. Afterward you can choose to erase the photos from the camera, some or all.

Photo! can also control the camera directly. Normally this is done with small buttons and a LCD display on top of the camera, showing shots taken and shots remaining, flash mode, etc. With the camera connected to Photo! you can also do things like select a specific shutter speed (normally you have no control, it's automatic) and set the date and time in the camera.

There is also a 'live preview' mode, where the image the camera sees is displayed on the computer screen every few seconds. This might be useful for things like technical close-up photography, where you must see the result as the lens sees it. The PhotoPC accepts standard 37mm camcorder closeup lenses for this purpose. When you like what you see you can click the mouse to take a photo. When Photo! is finished with its job you are left with a collection of .JPG image files, ready to view.

Here's where I will whinge about the PhotoPC a little. Under Windows 3.1, the filenames have a nice sensible format — MMDDNNNN.JPG, where MM is the month, DD is the day, and NNNN is the frame number. However under Windows 95, the software uses Win95's



Taken with the bright sun and a blue sky near Albuquerque, New Mexico. There are two people sitting on the face of the rock.

long filename capability in a rather excessive way: 'PhotoPC Monday, September 23, 1997 1008 AM 7.jpg'. These filenames are so big you must scroll all over the place to see them in a file display window. It would have been much simpler if Epson used the Win3.1 format in Win95 too. Or at least let the user make a choice...

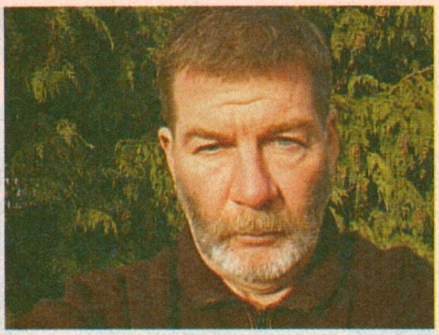
An important feature of the PhotoPC for graphics arts people is that it is 'Twain compliant'. This means it acts similarly to a photo scanner from a software point of view, and the camera can be used with any of the many graphics design packages that are also Twain compliant. This has got my hacking interest up, and I've recently downloaded an enormous file which contains the entire Twain standard. It would be good to be able to control the PhotoPC's features directly without going through all the kerfuffle of Windows and the Photo! program.

There seem to be two schools of thought about how digital cameras like the PhotoPC should be used. One opinion is that the pictures should be downloaded into the computer and then printed out on a colour printer. The resulting images are about the same physical size as chemist-shop photos. My daughter Fiona follows this thinking; she feels the pictures aren't real pictures if you can't hold them in your hand.

The other line of thinking (including mine) is that the photos will most likely *never* be printed; instead they can be viewed on the computer screen in a similar way that 35mm slides are viewed on a projection screen. Whether this is a viable option for you depends much on your computer's graphics capability.

My own Texas Instruments laptop came with a default video mode of 256 colours. This looked pretty good, and I used it for several months, converting any 16-million colour pictures to 256 before storing them away. But then a utility program that came with QPV (described below) revealed that my computer was capable of handling VESA modes right up through 16 million colours, even though the LCD hardware might only be good for 256.

I set up my system for 16 million colours (mode 112h as I remember) and was delighted to see photos take on a new life. The previous mode had been producing some colours by dithering. It looked OK until I saw VESA and the real thing. The moral of this story is, make sure your computer is configured for its best possible graphics mode, otherwise some of the charm of the PhotoPC's pictures will be lost.



A self-portrait of the author, taken with the Epson PhotoPC in low-res (320x240) mode.

Accessory software

The PhotoPC comes with a CD-ROM containing both IBM-PC and Macintosh software. Photo! is supplied for both platforms, and then there are some photo enhancing tools for both. For the PC, the main enhancing application is called PhotoPC 500 (how original!). This software lets you manipulate images from the camera to correct colour balance, sharpen or blur the image, and apply other special effects. There are also ways to create 'photo albums' of your pictures, turn them into cards or calendars, or show them as a 'slide show'.

My CD also came with a special printing program which I haven't even seen running yet. Why? Because I ain't got no CD-ROM drive! Lots of laptops don't, you know. So I faced the task of somehow extracting the software from the CD-ROM onto floppies, and then feeding the floppies to my laptop. You can get the software on floppies from Epson, but they want big bucks. Forget it; I decided to do it myself.

This was accomplished with the help of our old friend Elwha, the big Internet server computer which was the star of Moffat's Madhouse in March. Amongst all its other charms, Elwha has a CD-ROM drive, and a 3-1/2" floppy drive. I booted the machine from an MS-DOS disk and then investigated the contents of the CD-ROM. The Epson Photo! application was contained in several directories labelled 'disk-1', 'disk-2', etc, so it was a simple matter to copy each directory onto a floppy. The software installed from the floppies uneventfully.

As for the other programs, they didn't appear to be very floppy- friendly. So I decided to install them on Elwha itself, under Windows NT, and see what happened. The printing program crashed (according to Epson, none of the programs are supposed to run under NT) but both Photo! and PhotoPC 500 ran fine. When I saw what PhotoPC 500 actually did, I thought, "hey, I've already got one like that..."

Paint Shop Pro

Paint Shop Pro is a shareware program that can do just about anything to anything else in the graphics world. I am not a graphic artist, but I've been fooling around with PSP doing things like converting horror movie posters I've found on the Internet into 'wallpaper' for my Windows 95 desktop. You can also manipulate colours and image sizes, convert among many file types, and add special effects.

There is another program doing the rounds called Power Goo, bundled with some of the other digital cameras on the market. Power Goo has been ridiculed by several other reviewers, but considering how much fun I've had defacing things with PSP, Power Goo has to be on my shopping list. In the meantime, PSP will do you well as a program to manipulate your digital photos, both for serious work

Tom's very first shot taken with the PhotoPC camera, in a recording studio in Port Townsend, Washington USA. Lighting is by flash only.

and for fun. My current Windows 95 wallpaper is that photo of the Storm King ranger station. It's such a nice view to start a day's work...

Quick Picture Viewer

Paint Shop Pro is a very capable program, too capable in fact when all you want to do is look at and admire your pictures. You must go through an awful lot of mouse clicking just to get a picture onto the screen and then to full size.

I thought there must be a simpler way to do things, hopefully in MS-DOS instead of Windows. So I searched several shareware sites on the Internet and soon struck gold — a program called Quick Picture Viewer. QPV is primarily for viewing pictures of many different graphics formats. It can also tag, copy, and delete, but that's about it. And that's fine by me.

QPV presents a traditional MS-DOS file list and directory structure, through which you can move up and down with the keyboard or mouse. Every time you hit a graphics file, QPV displays a miniature version of it in the top centre of the screen, in black and white. This happens just about instantly, so you see a preview of what the file contains immediately the cursor touches it. If you want to view the picture full-screen you just hit <ENTER>.

You can hit <ENTER> over and over, and the program works its way down through the list showing each picture, very quickly since it's happening in MS-DOS. Furthermore, you can call up a slide-show mode and QPV will cycle through the pictures automatically, either in order or randomly, pausing on each one for a time you have specified. You can sit back, grab your tinnie, and congratulate yourself on your excellent photography as the pictures flash past. QPV was the star of the dinner party mentioned at the start of this article.

The Storm King ranger station in Olympic National Park, Washington.

I have decided, then, that Epson's PhotoPC is more than just a toy. I've already been asked by people here in Port Townsend to take photos of them and their kids and their cats and their dogs, for their personal web pages. If you visit our main home page here, **http://www.olympus.net**, you'll probably see one of my digital pictures plastered at the top.

One web page designer has expressed interest in the series of digital photos I took in Victoria BC in Canada, for a web page promoting tourism in towns near the Olympic Peninsula. So this digital photography is turning into Big Stuff!

For my own personal use, I've discovered that I can permanently store about 28 to 30 hi-res PhotoPC pictures on a 3-1/2" floppy disk. That's about the same as one roll of 35mm film. And the disk costs me 20 cents, instead of up to $20 for film and processing.

I can plug a disk into my A: drive and then turn QPV loose on it in slide-show mode. The floppy spins as each image is loaded the first time through, but after that they are all resident in the SmartDrive cache and all disks go to sleep. (Please, no comments about my audience...)

I know it's been said before, but after what I've seen here, I think film as we know it is going to go the same way as movie film. Still used in the most critical applications, but replaced by digital for everyday use.

These digital cameras are new, and still a little costly at this stage — $1158 for the PhotoPC 500 in Australia (tax included). You can also get an optional LCD viewing screen for 'through the lens' viewing, for another $434. But, like everything else electronic, they are likely to come down. When? The day after you buy one, most likely! ❖

This is not Russia, but the Victoria BC city waterfront, with Parliament House in the background. Taken with the Epson using available light.

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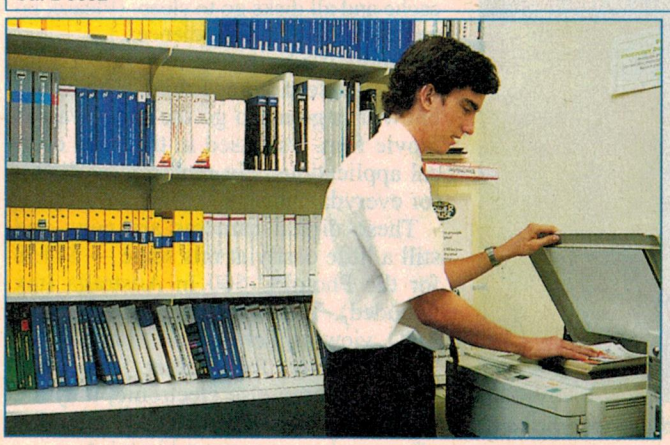

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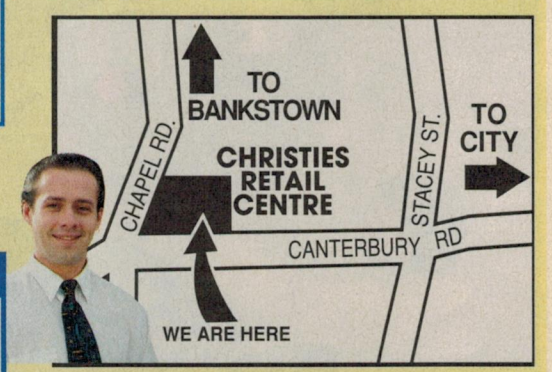

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GALILEO: HOBBLED, BUT STILL TELLING US A LOT

Although its high-gain communications antenna failed to open properly and its data recorder has malfunctioned, the Galileo spacecraft is still sending back an enormous amount of valuable scientific information on Jupiter and its moons during its two-year orbiting mission. How the mission has been 'saved' despite the malfunctions is a tribute to the innovation of JPL and NASA engineers...

by KATE DOOLAN

On January 7, 1610, Italian astronomer and renaissance man Galileo Galilei turned his newly acquired telescope onto the planet Jupiter. Apart from finding the giant planet, Galileo also discovered that the planet had four small moons orbiting it. This small discovery would revolutionise astronomy forever and change the way that humans saw their position in the solar system.

Some 385 years later, Mr Galileo would probably be amazed to learn that a robot spacecraft bearing his name would be making observations of Jupiter and its moons in a way that would have been unthinkable in the 17th century. I would love to know what he would have thought of his spacecraft when he learned that a part of it made a spectacular 'kamikaze' descent into the planet's atmosphere.

In December 1995, after a journey of six years and over a billion kilometres, Galileo became the first spacecraft ever to orbit our solar system's largest planet. Since then it has been returning stunning images and scientific data on an almost daily basis.

When I last wrote about this intrepid spacecraft, it was early in 1993 (see *EA* for May 1993). Little did I know that in the month after I finished writing my article, three astronomers working in California would discover a comet that would collide with Jupiter the following year, and the spacecraft Galileo would play a pivotal role in observations of the collision and the effects of it on Jupiter.

After finishing its second Earth fly-by in December 1992, Galileo proceeded to the asteroid belt and on 28 August 1993 flew past the asteroid Ida at an altitude of 2400 kilometres. Ida, which is 55km long, had a surprise for scientists back on Earth — a small moon about 1.5km in diameter and in orbit about 100km from Ida's centre. Later named 'Dactyl', after a group of mythological beings that resided on Mount Ida where the infant Zeus was hidden, the moon was found in a camera frame and an infrared scan.

Four months previously, on 23 March 1993, astronomers David Levy, Carolyn and Gene Shoemaker has discovered what they described as 'a squashed comet' using the 0.5-metre Schmidt telescope at the Palomar Observatory in California. Christened Periodical Comet Shoemaker-Levy 9 (P/CSL9), the comet (which was originally in a periodic orbit around the Sun) was captured by the gravity of Jupiter.

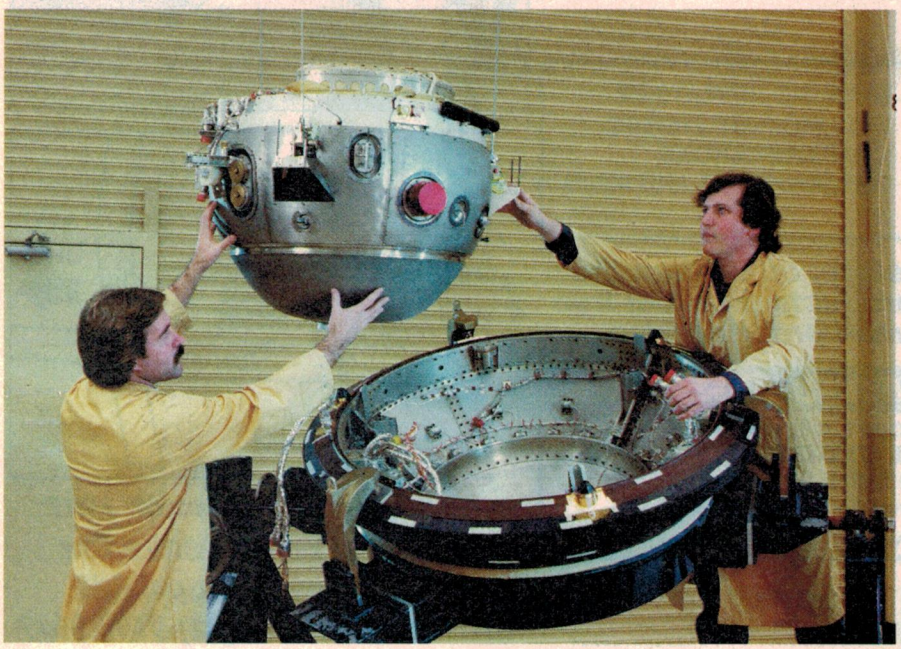
In July 1992, as it passed within 100,000km of Jupiter, Comet Shoemaker-Levy 9 may have broken into pieces. After calculations by both amateur and professional astronomers, it was publicly announced that CSL 9 would collide with Jupiter during the week of 16 - 22 July 1994. This coincidentally was the 25th anniversary of Man's first landing on the Moon!

It turned out that Galileo, which would be some 240 million kilometres from Jupiter in July 1994, would be the only scientific instrument to make direct line of sight measurements of the impacts.

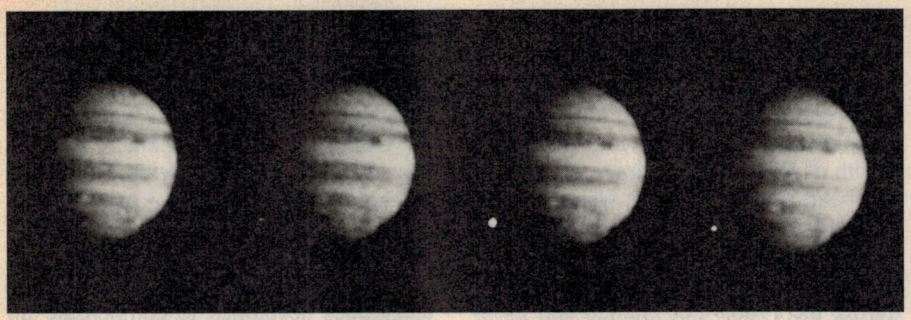
Program planned

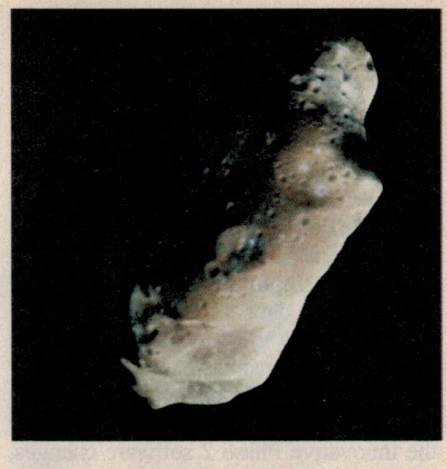
Although there was no funding available for Galileo to observe the CSL 9 impacts, an observation program was planned for Galileo's remote sensing instruments. All of Galileo's observations had to be programmed in advance into the spacecraft's computer, not withstanding uncertainties in the predicted impact times. The data was to be stored on the spacecraft (one tape load plus computer memory space) for playback at a 10 bits/second rate at a later time.

The impacts between Comet Shoemaker-Levy 9 and Jupiter were to be one of the most anticipated events in astronomical history. Burned by the publicity buildup for the return of Comet Halley in 1985/6, which turned out to be a



Technicians at Hughes Space and Communications carefully mating the Galileo descent module with its protective heat shield, during the final phase of assembly in 1989.





Some of the images sent back by Galileo. Above are four images showing the impact of fragment W of the Shoemaker-Levy on the dark side of Jupiter, on 22 July 1994, while at right is an image of asteroid 243 Ida, taken on 28 August 1993 at a range of 10,500 km.

flop, many astronomy and space buffs (including me!) played down the upcoming impacts. Happily we were to be proved very wrong...

The first impact between CSL 9 and Jupiter occurred at 5:55am (AEST) on 17 July 1994, when fragment 'A' smashed into the planet. Soon after the impact, the Calar Alto Observatory in Spain reported infrared observations of the impact area. Three hours later, a Hubble Space Telescope image in the visible spectrum was released to the waiting world showing the Calar Alto images were not a fluke.

Over the next week, fragments slammed into Jupiter with startling regularity. The first impact, which was only a small one, caused a fireball to shoot 1600km out in space and left a dark 'bruise' on the planet's clouds. The largest fragment 'K' hit Jupiter at 8:20pm (AEST) on 20 July, and its brightness nearly blinded observers using Earth bound telescopes. By the time of the last impact, Jupiter was sporting a series of dark bruises across its face. All of the impacts were visible for several days after the collision.

Galileo's imaging system used different methods to cover the time uncertainties (which amounted to hours) of the impacts for different events. Repeated imaging captured the last impact (fragment 'W'), which appeared to last for 26 minutes. A smeared image showed a streak representing the night side impact fireball, among smears showing Jupiter and some of its moons, and provided brightness histories of two events — the impacts of fragments K and N.

The photopolarimeter-radiometer detected three events. The IR spectrometer detected two events, providing critical data on the size, temperature and altitude of the impact fireball and the heating of Jupiter's atmosphere by the impact 'fallbacks'. Galileo project scientists have combined this data to produce an interpretive history of the 90-second impact events.

Antenna problems

Due to problems with Galileo's high-gain antenna (HGA), data from the CSL 9 impacts were not finally transmitted until January 1995. With the failure of the HGA antenna, engineers at the Jet Propulsion Laboratory in Pasadena, California had successfully devised several creative techniques to enable the spacecraft to achieve the majority of its scientific objectives.

By way of background, on 11 April 1991, after Galileo had travelled far enough from the heat of the Sun the spacecraft executed stored computer commands designed to unfurl the large high-gain antenna. Telemetry received minutes later showed that the antenna had only partially opened. During the next couple of weeks, JPL engineers analysed telemetry and conducted ground testing with an identical spare antenna. It was deduced that the problem was caused due to the sticking of a few antenna ribs, caused by friction between their standoff pins and sockets.

The Galileo team sent a variety of commands to the spacecraft in an attempt to free the antenna. Most involved turning Galileo towards and away from the Sun, in the hope that warming and cooling the HGA would free the stuck hardware through thermal expansion and contraction. None of these attempts succeeded in freeing the ribs.

Further engineering analysis and testing suggested that 'hammering' the antenna deployment motors (turning them on and off repeatedly) would deliver the force that would be required to free the stuck pins and open the antenna. After more than 13,000 hammerings between December 1992 and January 1993, telemetry showed that additional deployment force had been generated — but the ribs had not been freed.

Other approaches tried included spinning the spacecraft up to its fastest rotation of 10 revolutions per minute and hammering the motors again, but these efforts were doomed to failure.

One final attempt to free the HGA was made in March 1996, after the spacecraft's main engine was fired to raise Galileo's orbit around Jupiter. This 'perijove raise manoeuvre' delivered the largest acceleration the spacecraft had received since its launch in 1989, and followed three other mildly jarring events — the release of the atmospheric probe, the orbiter deflection manoeuvre and the Jupiter orbit insertion engine firing. It was hoped that these shocks would jar the stuck ribs enough to free the antenna. This was the last attempt to open the antenna before new software was radioed to the spacecraft to begin the advanced data compression techniques that were specially designed for use with the low-gain antenna. Unfortunately, these procedures were not successful.

The difference between Galileo sending its data back to Earth using the high gain antenna and the low gain antenna (LGA) is like the difference between the light from a spotlight versus the light emitted from a light bulb. If it had unfurled, the HGA would have transmitted data back to the ground based Deep Space Network (DSN) collecting antennas in a narrowly focused beam. The LGA transmits in a comparatively unfocused broadcast, and only a tiny portion of the signal actually reaches the DSN antennas. Because the received signal is 10,000 times fainter, data must be sent at a lower rate to ensure that the contents are reliably received.

The key to the success of the mission are two sets of new flight software. The first set, called Phase 1, began operating in March 1995 and was designed expressly to partially backup and ensure receipt of the most important data collected from the atmospheric probe. Once the critical scientific data from the probe was safely returned to Earth, a second set of software

was radioed and loaded into the spacecraft during March 1996.

The Phase 2 software included programs to compress the voluminous science data that the Galileo orbiter collects and stores on its tape recorder during its two year mission, whilst retaining the scientifically important information and returning that data at the lower data rate.

Without any new enhancements, the LGA's data transmission rate at Jupiter would be limited to only 8 - 16b/s, compared to the HGA's 134,400b/s. However the innovative Phase 2 software changes, when coupled with hardware and software adaptations at Earth-based receiving stations, increases the effective data rate from Jupiter by as much as 10 times, to 160b/s.

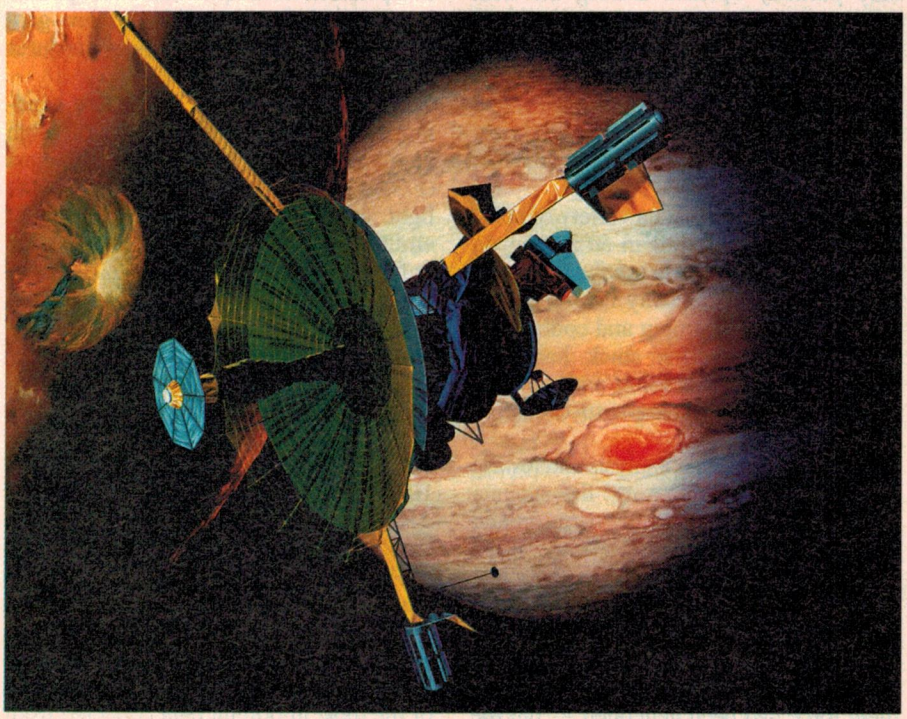
The data compression allows retention of the most interesting and scientifically valuable information, whilst minimising or eliminating less valuable data such as the dark background of space. Two different methods of data compression are used. In both methods, the data is compressed onboard the spacecraft before being transmitted to Earth.

The first method, known as 'lossless' compression, allows the data to be reformatted back to its original state once on the ground. This technique is routinely used in personal computer modems to increase their effective transmission rates. The second compression method is called 'lossy', a term which in this case refers to the loss of some original data through mathematical approximations. Lossy compression is used to shrink imaging and plasma wave data down to as little as 1/80th of its original volume.

S-band communications were once the standard for space missions, and several S-band performance enhancing capabilities were implemented at DSN stations during the 1980s. For Galileo and its S-band low-gain antenna, these capabilities are being restored on the 70m antenna at the DSN station located at Tidbinbilla in Australia's ACT (see *EA* November 1996). Because Australia is in the southern hemisphere and Jupiter is in the southern sky during Galileo's mission, the Tidbinbilla complex is receiving most of the spacecraft's data.

Another critical and ongoing DSN upgrade is the addition of 'Block V' receivers at the tracking stations. These receivers, which are being used for multiple missions, will allow all of Galileo's signal power to be dedicated to the data stream by suppressing the traditional carrier signal — allowing use of higher data rates.

Starting early in Galileo's orbital tour, the 70m and two 34m DSN antennae at Tidbinbilla were all arrayed to receive the spacecraft's signal concurrently, with the received signals electronically combined. The arraying technique allows more of Galileo's weak signal to be captured, again allowing a higher data rate. In addition, other arraying has been carried out with the CSIRO's 64m Parkes Radio Telescope. As well, the 70m antenna at the DSN station in Goldstone, California has also been arrayed with Tidbinbilla when their views of Galileo overlap.



An artist's conception of how galileo should have looked, in space near Jupiter, if its high-gain antenna dish had deployed correctly. Although this didn't happen, ingenuity has allowed the mission to deliver much more information than expected.

Recorder malfunction

Galileo's tape recorder is the key link in techniques developed to compensate for the loss of the spacecraft's high-gain antenna. The tape recorder is used to store information, particularly imaging data, until it can be compressed and edited by the spacecraft's computer for transmission back to Earth by the LGA.

With less than two months to go before arrival at Jupiter, Galileo's tape recorder malfunctioned on 11 October 1995. Data from the spacecraft showed that the tape recorder failed to cease rewinding after recording an image of Jupiter.

A week later, following extensive analysis, the spacecraft's tape recorder was tested and found to be still operational. However, a detailed study of engineering data showed that the tape recorder can be unreliable under some operating conditions. The problem appeared to be manageable and would not jeopardise return of the full complement of images of Jupiter and its moons, which are stored on the recorder for playback over the course of the two year mission.

On 24 October 1995, the spacecraft executed commands for the tape recorder to wind an extra 25 times, around a section of tape that may have been weakened when recorder had been stuck in its rewind mode with the tape immobilised for 15 hours.

Due to uncertainty about its condition, engineers decided that the portion near the end of the tape reel is 'off limits' for future data recording. The extra tape wound over it secured the area of tape and eliminated any stresses that could tear the tape at that potential weak spot.

Unfortunately, this meant that any images that Galileo took of Jupiter until then would not be played back to Earth. This also meant that the spacecraft would not image Io at its closest approach of 600km, on the day that Galileo went into orbit around Jupiter. Instead, the tape recorder was devoted to gathering data from Galileo's probe as it dived into Jupiter's atmosphere.

Very few of Galileo's original measurement objectives were abandoned due to the loss of the high-gain antenna. For the most part, scientific investigations on the spacecraft have been adapted to the lower data rates using a variety of techniques depending on the nature of the experi-

ment. The new software and DSN receiver hardware increased the information content of the data that is being returned by at least 100 times what would have been possible otherwise.

The onboard data processing made possible by the Phase 2 software allows Galileo to store and transmit nearly continuous observations of the Jovian magnetosphere, along with extensive spectral measurements of the planet and its moons in the visible, infrared and ultraviolet. This includes more than 1500 high resolution images.

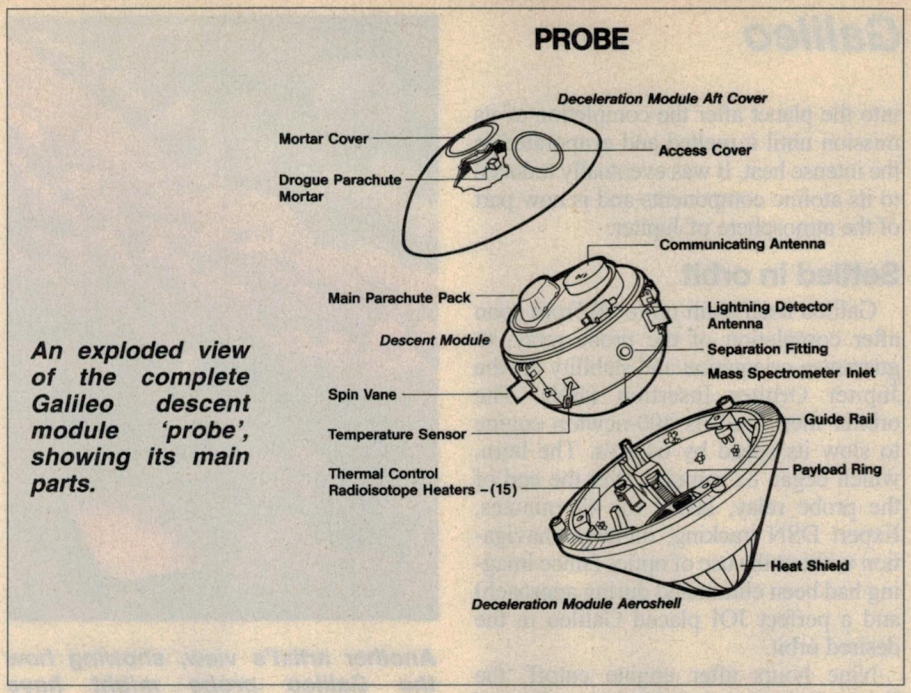
Whilst tens of thousands of images would be needed for large scale motion pictures of Jupiter's atmospheric dynamics, the hundreds of images allocated to atmospheric imaging will allow in depth study of several individual features in the clouds of the planet. Cooperative observations with the Hubble Space Telescope and ground based observers have long been planned as part of the Galileo mission, to provide information on the global state of the planet's atmosphere.

For the orbiter portion of the Galileo mission, it is useful to learn that the spacecraft with its sophisticated instruments, closer satellite flybys and long duration in Jupiter orbit was specifically designed to answer many of the questions that the Pioneer and Voyager spacecraft were unable to visit in their short flybys. None of these characteristics has been affected by the loss of the HGA, only the total amount of data reduced. This means that when Galileo examines a class of phenomena, fewer samples of that class can be studied and often the spectral or temporal resolution will be reduced to lower the total volume of data. The resulting information will still provide a unique insight into the Jovian system.

Dust storm

During mid 1995, Galileo found itself flying through one of the most intense interplanetary dust storms ever measured. It was the largest of several dust storms that the spacecraft had encountered since December 1994 when it was some 175 million kilometres from Jupiter. The dust particles are thought to originate from somewhere in the Jovian system and may be produced from the volcanic moon Io or from the planet's ring system. The particles, which are no larger than those found in cigarette smoke, could also be leftover material from Comet Shoemaker-Levy's impact with Jupiter.

Scientists believe that the particles are electrically charged and then accelerated by Jupiter's powerful magnetic field. Calculations have suggested that the dust is speeding through interplanetary space at a rate between 40 and 200km/s. Even at these speeds, the particles are no danger to Galileo because they are so small.



An exploded view of the complete Galileo descent module 'probe', showing its main parts.

Probe released

On 13 July 1995, the Galileo spacecraft spun up to a rate of 10.5rpm and aimed its atmospheric probe towards its Jupiter entry point, some 82 million kilometres away. Guillotine-like cable cutters sliced through umbilicals connecting the two spacecraft and the probe was released for its solo flight to Jupiter.

Finally, it was Arrival Day for Galileo itself, on 07 December 1995. This day was to be one of the busiest for the Galileo team as the probe entered the atmosphere and the orbiter would encounter two of Jupiter's moons as well as placing itself into orbit around the planet.

Six hours before the probe did its kamikaze act into Jupiter's atmosphere, the command unit signalled the probe to wake it up and three hours before entry, the scientific instruments began to collect data on lightning, radio emissions and charged particles.

The probe had to strike Jupiter's atmosphere at an angle of only 8° — steep enough so it would not skip out into space, yet shallow enough to survive the heat and deceleration of entry. The probe would be entering near the planet's equatorial zone and would travel in the same direction as the planet's rotation.

As the probe entered Jupiter's atmosphere, it was subject to wrenching forces as it decelerated from 170,000km/h to 160km/h in two minutes. This produced a force estimated to be 230 times Earth's gravity.

After the probe had slowed sufficiently, its parachutes opened and 35 seconds later, it started to transmit to the orbiter at 128b/s. The probe transmitted reports on the sunlight and heat flux, temperature, pressure, lightning activity, winds and composition, as well as the structure of the atmosphere and energetic particle measurements acquired during the pre-entry phase. Only traces of the anticipated ammonia and ammonium hydrosulphide cloud layers were detected.

Eight minutes after the probe had entered the atmosphere, it was expected to approach the tops of the water clouds; but none were encountered. The probe sensed stronger winds than expected, and evidence of distant but very intense lightning.

The probe's internal temperature was more closely coupled to that of the atmosphere than had been expected. As a consequence of this, the scientific instruments exceeded operational limits — but they continued to work. To confirm the accuracy of the data acquired by the instruments at lower altitudes and under extreme conditions, scientists planned to recalibrate some of the flight spares tested to the actual temperature profiles experienced by the probe.

Thirty two minutes after entry, the orbiter's articulated relay radio antenna slewed to compensate for the probe's changing position below it. The spacecraft slewed three more times at 10 minute intervals to maintain lock. The probe continued to transmit data for 57.6 minutes when it had reached some 140 kilometres into the planet's atmosphere. Scientists believed that the probe continued to fall

into the planet after the completion of its mission until it melted and evaporated in the intense heat. It was eventually reduced to its atomic components and is now part of the atmosphere of Jupiter.

Settled in orbit

Galileo itself spun up to 10.5rpm soon after completion of the probe relay, to guarantee orientation and stability for the Jupiter Orbiter Insertion (JOI). The orbiter then fired its 400-newton engine to slow its speed by 643m/s. The burn, which began 82 minutes after the end of the probe relay, lasted for 49 minutes. Expert DSN tracking, on-target navigation without the use of optics (since imaging had been eliminated during approach) and a perfect JOI placed Galileo in the desired orbit.

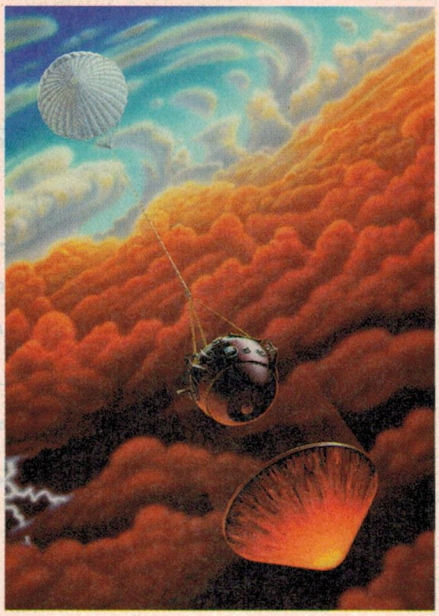
Nine hours after engine cutoff, the Earth disappeared behind the disk of Jupiter. Fifty minutes later, the Sun passed behind the planet as well and the orbiter was in darkness. After 3.5 hours of radio silence, the Earth reappeared to the orbiter and contact was re-established. After a journey of six years and over a billion kilometres, Galileo had finally arrived at Jupiter.

Galileo's two-year orbital tour of the Jovian system is an elaborate dance requiring the spacecraft to swing around one moon to reach the next. The Ganymede encounter on 27 June 1996 was the first of these satellite 'swing bys', shortening and changing the shape of Galileo's ensuing orbits.

Each time the spacecraft flies closely past one of the major inner moons, its course is changed due to the moon's gravitational effects. Careful targeting allows each flyby to direct Galileo onto its next moon encounter and the spacecraft's orbit around Jupiter.

Galileo has already flown by Ganymede twice and will do so another twice. Both Callisto and Europa will receive three flybys over the next two years. Io only received one close pass on 07 December 1995 because Galileo cannot hang around in the hazardous radiation environment in which Io resides without damaging the spacecraft's electronics.

The encounters with these Jovian moons will be at altitudes as close as 200 kilometres above the surfaces of the moons. Typically, these altitudes are 100 to 300 times closer than the Voyager 1 and 2 flybys. The flybys will determine chemical composition, geological feature and geophysical history studies. Galileo's scanning instruments scrutinise the surface and features of each moon. After a week of observations with the tape recorder full of data, the spacecraft spends the next months in orbit relaying the information back to Earth.



Another artist's view, showing how the Galileo probe might have appeared when it began its 'kamikaze' descent into Jupiter's atmosphere on 7 December 1995.

Throughout the two-year tour of Jupiter, Galileo will also monitor the planet itself, exploring it in greater detail than has been done previously.

Galileo's tour of Jupiter consists of 11 different elliptical orbits around the planet. Each orbit (except one) includes a close flyby and gravity assist from Ganymede, Europa or Callisto near the Jupiter end of the orbit. The outer ends of the orbits will vary from 5 to 20 million kilometres.

No close flyby is planned for orbit five, during January 1997, as Galileo will be out of communication due to a solar conjunction — the Sun will be between Jupiter and Earth. Distant scientific encounters with other Jovian moons are planned and the spacecraft will observe Io at medium range on every orbit.

Extensively bombed

During Galileo's encounter of Ganymede in June 1996, the spacecraft found that the moon has been extensively bombed by comets and asteroids. The largest moon in the solar system, Ganymede was also found to be wrinkled and torn by the same forces that make mountains and move continents on Earth.

The moon was also found to have a magnetosphere, which is a bubble-shaped region of charged particles that surrounds many of the planets but has never been found to exist around a moon. Possible sources of the magnetic field include a molten iron core, or even a thin layer of salty water underneath Ganymede's crust.

New images of Europa released in August 1996 indicate that 'warm ice' or even liquid water may have existed, and perhaps still exist, under its cracked icy crust. The images, which resemble ice floes in Earth's polar regions, show suggestions of geyser-like eruptions and details of long dark bands centred with white stripes. These results will bring scientists a step closer to determining whether Europa has an environment warm enough to meet the requirements to support life.

An image of Io released at the same time shows a new volcanic plume that extends some 100km into space. The volcano Ra Patera has undergone dramatic surface changes since the Voyager flybys in 1979. An area around this volcano the size of 40,000km^2 has been covered by new volcanic deposits since 1979.

Kepler's directive

In April 1610, the great German mathematician Johannes Kepler wrote to his friend Galileo:

There will certainly be no lack of human pioneers when we have mastered the art of flight. Let us create vessels and sails adjusted to the heavenly ether and there will be plenty of people unafraid of the empty wastes. In the meantime, we shall prepare, for the brave sky travellers, maps of the celestial bodies. I shall do it for the Moon — you, Galileo, for Jupiter.

Galileo's 20th-century alter ego is certainly carrying out that far sighted directive.

In closing, the author wishes to thank Colin Burgess and Debbie Dodds of the Johnson Space Centre, and Jim Elliott and Mary Hardin of the Jet Propulsion Laboratory, for their valued assistance in the completion of this article. All photos are courtesy of Hughes Aircraft Company and NASA.

I would also like to recommend the following books, for anyone interested in learning more about Galileo and Jupiter:

Galileo — Decisive Innovator, by Michael Sharrat, Cambridge University Press 1996.

The Giant Planet Jupiter, by John Rodgers, Cambridge University Press 1995.

The Great Comet Crash, edited by Jacqueline Mitton and John Spencer, Cambridge University Press 1995.

Impact Jupiter, by David Levy, Plenum Press 1995. ❖

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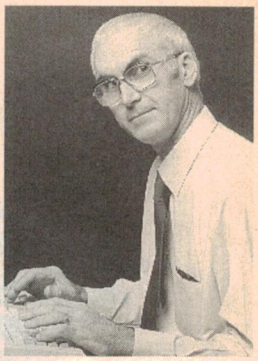


The pay rates and status of electronics technicians — more support for 'P.R.'

As I predicted last month, we're going to take a short break from the thorny subject of EM fields and health. In fact this month I thought we'd return to another subject which although not technical, is clearly capable of stirring up even stronger feelings among our technical readers: the relatively low pay rates and status offered to electronics technicians, especially in Australia and New Zealand. It's understandable that it *does* get people stirred up, too...

You may recall that we discussed the subject of pay rates for electronics technicians a couple of times last year, in the June and September columns. In the June column I printed a sobering and heartfelt letter from a reader from Crows Nest in NSW, who wanted to be identified simply by the initials 'P.R.'.

The reader concerned had recently returned to Australia from some years abroad, and was shocked to find just how low the pay levels and status of electronics technicians and engineers were here, in comparison with other countries. He even found an advertisement offering higher pay for a street sweeper, than recent ads for electronics technician positions.

Needless to say quite a few readers sent in responses to P.R.'s letter — virtually all lending their support — and I printed a number of them in the September column. However while we've been looking into the possible health risks of EM fields the responses have continued to come in, and as a result I thought we'd look at some of them this month.

The first one I'd like to draw to your attention comes from Mr M.M. Gell, of Glenelg South in SA. Mr Gell actually makes a comment about the EM fields/health topic as well, as you can see:

The reports in your column about the risks involved with the use of mobile phones and "The possible health risks of E-M fields; more food for serious thought" is all extremely interesting. But may I humbly suggest that there must be many EA readers like myself who would like to read such scientific reports but cannot afford prices like $14.95 and $35.00, all plus postage. Would it be possible for EA to publish these reports in serial form each month?

Two other matters I found of interest in your column are the articles on technician pay rates and unsafe appliances, in the September '96 issue of EA.

I would seriously suggest that ALL technicians working in forms of technical work from TV servicing through a whole range of electronics work should form a very large and strong trade union, and to be a recognised and qualified technician in this area membership of such union should be compulsory! This would just guarantee that all duly qualified personnel were paid the correct and appropriate salary. The present government policy of watering down the Industrial Relations Act is the thin edge of the wedge, to ensure that people were paid slave labor salaries/wages. If highly trained people in this area want wage justice, they will need to 'get political'.

With regard to unsafe appliances, apart from being unionised all highly trained people in the electronics industries will need to be licenced by an appropriate government department, similar to those who administer licencing of builders and electricians.

Unsafe appliances will become prolific, under all governments' policy of deregulation. About two or more years ago now the state governments of Vic and SA abolished the need for motion picture projectionists to be licenced, under the heading of deregulation. Which means in effect any unqualified person can be employed in this capacity, for less than the award wage. No individual has the power or strength to argue a case against any large employer or multinational concern.

I firmly believe that any lucrative labour contract offered initially will be progressively watered down, while the CPI goes up!

Thanks for those comments, Mr Gell. I take your point about the non-trivial price of many of the printed reports about EM fields and health, and we'll try to publish more of this material in the magazine when this is possible. Of course the authors of many of the reports have often put a lot of work into both the reports and the work they describe, and understandably may want to get some compensation in return (unless they're like Professor Adey, whose work is paid for by the US taxpayer). When we publish some of this material, that tends to reduce the number of reports they sell, and reduce their compensation. So we have to tread a careful path.

Collective strength helps

Your suggestion that technicians form a strong trade union or similar organisation to represent their interests is undoubtedly a good one, for the reason you give: it's very difficult for an individual to argue a case against a large employer or multinational concern, and obtain ongoing equitable treatment. However I'm not sure how many will be keen on your idea of making membership of such a union compulsory, for any recognition of their qualifications. I guess many of us see compulsory unionism as an infringement of individual rights, and also as being likely to encourage corruption of union officials. What's that old saying? 'All power corrupts, and absolute power corrupts absolutely'...

You may also be right about the need to license service technicians, although I imagine there will be a lot of existing technicians who won't be too keen on this either. Those who are strong in experience but weak in terms of 'paper qualifications' may be worried that they would have difficulty gaining one

of your licences. But let's turn now to the next response, which comes from Mr Jack Gill of West Moonah in Tasmania. Mr Gill also believes the only real remedy for low pay rates is to achieve stronger industrial representation:

I have followed the debate in your magazine on the low wage rates paid to electronics technicians for quite a while now. I write to explain why I think their wages are so low.

By the end of the last century, Australia's private sector had developed into a large group of businesses who employed a workforce in many identifiable occupations. Employer business associations formed to represent the businesses and company's interests and keep wage demands under control.

Trade unions were formed by workers who wanted industrial organisations to represent them in the workplace and argue for improvements to their pay rates in the courts of the day.

Early this century the first Industrial Relations Act appeared to take over the role of the courts. The umpire in this is the Australian Industrial Relations Commission (AIRC), with various state systems in place as well. Over time a number of wage cases leading to setting minimum wages for groups of workers within occupations and industries became the standard. This being done through a system of awards that specify wages and conditions.

For all sectors to be treated equally it relied on active representation from both unions representing their members, and employer associations representing their members. These wage cases became a major part of the unions' and employer associations' work. These awards have varied dozens of times over the years since.

Unions that have had active rank and file participation are the ones who have been in the lead, with higher wages for their respective occupational membership groups. All the lower paid occupational groups have remained mainly ununionised and this is the problem.

These groups have not had the same arguments applied because in the main there has not been any united force pushing to make it happen for them.

Thanks for a great magazine and an interesting read every month.

Thanks for your contribution too, Mr Gill. I'm sure that both you and Mr Gell are right, in that the 'survival of the fittest' principle embodied in the capitalist system tends to mean that those who are not able to exert enough 'might' to preserve their rights are likely to lose them. Hence the only real way to ensure that your pay rates and status are preserved *is* probably to have sufficiently strong representation.

I suppose the aspect that puzzles me about this situation, with regard to electronics technicians, is why those in Australia (and presumably New Zealand as well) have been relatively weak in terms of their industrial organisations — because that's presumably why their status and pay rates *are* relatively low, compared with that of their counterparts in other developed countries. It's a bit strange, don't you think, when Australian workers have traditionally been relatively strong in terms of their industrial organisation?

Non joiners?

Perhaps there's something about the type of person who is attracted into technical fields like electronics, that makes them relatively disinclined to join unions or other similar organisations. I don't know, but if so it might explain why the salaries of many scientists and researchers are also somewhat lower than you'd expect...

Moving on again, though, our next contribution is one that like our original

letter from 'P.R.' clearly comes right from the heart. It comes from Mr Marcin Frankowski, originally from Warsaw in Poland, but currently living in Wellington, New Zealand.

Mr Frankowski's letter was very long, about 5-1/2 pages of close typing, and he writes that he doesn't expect I'll be able to reprint it in full. However because he raises so many interesting points and makes them with such strong conviction, I'm going to fit in as much as I can. Here goes:

I have found the matters raised both in Mr/Ms P.R.'s letter and your comments to it of great interest and equally great relevance to me, to the profession as a whole and to the future of the electronics industry in Australasia. Although I am writing from a New Zealand perspective, the general situation and trends in Australia's and NZ's electronics are very similar — which is understandable taking into account the common ancestry of their colonists, similar paths to and foundations of statehood and the fact that New Zealand is proceeding to integrate with Australia and eventually cease to be a separate country (I know that some close-minded Kiwis are going to hate me for saying that, but I couldn't care less).

I hasten to add that I have immigrated (or rather made a serious error of judgement to immigrate) to New Zealand only a few years ago, after having a very successful career in electronics design in Poland and West Germany. So I have a first-hand knowledge of the operating methods of the world's most advanced and internationally renowned electronics industries, and social attitudes that made this success possible. Also as an outsider I could see and identify many things in New Zealand that for the local population are part and parcel of the system they are conditioned to conform to fully and without question from birth to death. And yes, you guessed correctly, our professional engineering staff are being paid many times the street sweeper's rate.

After reading your correspondent's letter I couldn't agree more with the points raised. But drawing on my personal and reliable general experiences, I would offer alternative explanations of the sources of the problems raised — and I invite all for a discussion and I am ready to defend my position.

The first thing that I agree wholeheartedly with P.R. is lack of positive public perception of technical professions. But I claim that there is much more to it that just some Hollywood movies and some supposed attitudes of British pre-war aristocracy.

First and foremost, the profession is to blame for failing to establish and consistently maintain job and professional titles that would differentiate clearly between various levels of skills and responsibility. Unlike in Continental Europe, here job titles like technician and engineer are pretty much interchangeable and merely show the fact of being employed in a technical sector (in the widest sense).

I have seen here billboards advertising services of welding as 'welding engineer' and advertisements of vacancies for R&D technicians, and 'general engineering' used to describe such definitely low-tech tasks like earth moving or concrete laying. 'Engineer' traditionally means a locomotive driver, but equally may mean drainlayer, electrical appliance repairman, and research scientist. No wonder then that general public associate 'technician' and 'engineer' with the level represented by these traditional, long-existing occupations. How can anybody tell what sort of engineer you are if you just say "I'm an engineer"?

In Continental Europe there is no such problem, because there is an exactly prescribed gradation of technical professional titles awarded after completing prescribed courses of theoretical and/or practical education (or satisfying a relevant education authority that an equivalent level of knowledge and skills has been achieved through other ways of study) and passing comprehensive examinations. This in itself is nothing revolutionary, but in Europe one is not permitted to use a title that one was not awarded. This at least takes care for the problem associating research scientists with 'Mr Fix-it' types.

Why not introduce similar gradation here? It might catch on especially well, if 'Electronics Australia' endorsed it. Professional titles in Europe may have different names from country to country, but follow roughly the same pattern (from bottom to top):

1. Unskilled labourers and apprentices (includes manual loaders, diggers, cleaners, garbage collectors etc., and those learning);

2. Skilled (or qualified) labourers (circuit assemblers, fitters, welders, drivers, crane operators, wirers, installers);

3. Experts, technicians and engineers (electronic and computer equipment service people, quality controllers, laboratory personnel, draughtspeople, designers, video/sound engineers/producers, managers);

4. Academically-trained engineers, holders of MSc in engineering (designers, research personnel, video/sound engineers/producers, managers);

5. Scientists, researchers (research personnel, academic lecturers).

I found it quite unpleasant after my arrival in New Zealand that, when introducing myself to other people, I had to explain at great lengths my professional level (and the fact that I was neither a circuit assembler nor 'Mr Fixit', capable of fitting switches to night lamps). So I have invented a very nice title and introduce myself as a 'scientist-engineer' — and am quite happy with people's reactions for it.

A close second in things that are responsible for the problem is an apparent willingness to accept very low wages and unwillingness to use democratic rights to gain better conditions by the profession. Both P.R. and the editorial comment stated matter-of-factly that technical people are in the end accepting such conditions.

Money controls status

You should see that in the materialistic society based on wild capitalism, where access to everything depends on money, one's social position depends nearly solely on one's material assets. Of course certain non-profit activities are highly commendable, but presenting a company's owners or shareholders with free gifts (in the guise of cheap labour) is nothing short of bizarre!

I would see increasing the salaries to the average level of others like businessmen, lawyers and physicians the only way to put the matter on track towards improvement. There are many ways to achieve at least substantial improvement: not to accept such low-paying positions (and persuade others to join this boycott); getting together and organizing a strong trade union and lobbying group, or founding a political party and standing in the parliamentary elections.

Unfortunately, waiting for a Messiah or humbly asking for anything will not improve the lot of technology-based occupations. But after some years here my observation is that the only engineering people willing to take care for their lot like adults are immigrants — locals either are passive or turn downright hostile to the idea of changing any-

thing. (In Europe it is normal to refuse a low-paying job. Even more, it is a shame to work for rubbish, and to support a system that does not give justice to one's interests.) But immigrants, as a minority, cannot change the situation without profession-wide support.

Also very damaging to the causes of science, modernization, technical progress, life improvement etc. are claims of the virtue of 'hard work' (and implied, a hard life). Of course both the way a scientist works, and the purpose of such work, are a negation of the hard work principle. Scientists work to make human work easier and more efficient, and ultimately to free people from hard work.

In today's developed countries the important thing is to work efficiently, not harder. And yet I see in nearly all vacancy advertisements a requirement for a 'hard-working individual'! I don't know why somebody should 'work hard' for example as a producer of a recording of a opera — perhaps he/she should carry a pianoforte around a stage on their own back, not using the wheels fitted to the instrument's legs. Or as an electronics researcher (this one should probably get himself a crank-driven dynamo, to use it instead of mains power).

Perhaps it is time to remind your readers that 'hard labour' was used extensively by the Nazis and Soviets, to eliminate 'undesirable elements'. The cruelty of it was that the inmates were watched so they didn't improvise any ways to allow them to fulfill their work quotas with less effort — i.e., they were not permitted to work more efficiently.

I myself have had many experiences in NZ with employers (who should be most interested in efficiency and optimization of work) having a negative reaction when I explained that I am concerned far more with efficiency (understood as planning and organizing work so as to deliver a required product or effect while using a minimum amount of effort and wastage) than with showing myself as a 'hard worker'.

Most developed countries value efficiency and also ergonomics, the science about making all tasks — in both the workplace and in everyday life — easier and faster to learn and to do. The co-founder and one of the most important people in ergonomics was internationally renowned Polish Professor Tadeusz Kotarbinski.

The only explanation I can find for this sorry state of affairs in Australasia is that the general education does not teach nor show pupils what scientific work is all about, what is the purpose of such work, what skills are necessary for such work and how much effort it takes to learn these necessary skills. By and large the population is totally ignorant that scientists and researchers not only sit in comfortable chairs, read something and sometimes scribble something down. Unfortunately, the general population does not realise that scientists are not paid for the task of writing (which in itself is neither hard to learn nor complicated enough to deserve special social recognition), but what they write which is at stake.

In other leading countries this problem is not significant, perhaps for the following reasons:

- *Schools, parents and youth publications present fairly comprehensive descriptions of duties and requirements for various occupations (with visits to selected companies);*
- *In these countries the educated people are neither quiet and humble, nor apologize for being educated and not working hard.*
- *In our countries people in general regard it as normal to improve one's quality of life, e.g., by using various products of technical thought to make tasks easier and for pleasure. Hence there is a strong demand for quality, suitable parameters, durability, accessibility etc. of technical products — and regard for those who create these products. (And those who create such products feel no obligation at all to supply these products without appropriate financial gratification.)*

Status, not utility

Here in New Zealand a very significant part of society treats most modern (and not so modern) technical products as merely status symbols, where the only things that count are external appearance and price tag (and, associated with it, the country of origin). For such people the existence of modern technologies means merely a social necessity of spending big (or even bigger) money on things they neither need nor know how to use — but must have them just to show themselves off. So they do not feel like appreciating the engineers.

Ubiquitous computers come immediately to mind. Everybody, including domestic cleaners and lawnmowing contractors with just a couple of customers, 'must' have one here, when paper grids and hand-written invoices are not only cheaper, but much faster to fill in. Faxes come a close second; as long as I have had one, and it is a couple of years, I've received plenty of letters from Anglo-Saxon sources — even when faxing them would be cheaper

than mailing them — and only two faxes. Other nationals use faxing as a normal way of communication.

On the other hand, another, also very sizeable part of NZ society believes that there is no real difference in quality and durability between products 'made in China' (or Korea, Taiwan etc.) and better models — the other ones are merely more expensive.

I remember a correspondence by the BBC on social matters in various parts of the world. It stated that in France, as well as in other countries of Continental Europe, the top of the social ladder belongs to intellectuals, artists and professionals (they are yuppies in our countries, not businessmen and financiers like in Anglo-Saxon countries). Businessmen and administration clerks are far behind; they are sometimes merely tolerated, and sometimes are treated as social parasites that siphon out money disproportionate to their work's value and for the most time they only obstruct economic and social functions of the economy.

Such attitudes are promoted by our societies and governments. From this it follows that our managerial cadres must know the field they are managing (on average only company directors and executives have solely business education, others are professionals — our educational system provides managerial skills to professionals), as nobody would ever feel obliged to quietly fix things so that the manager can feel important and indispensable.

Perhaps our appreciation of practical skills can also be traced to the numerous wars and armed conflicts across Europe, that would cause great or total losses of people's material possessions and savings, and result in an arms race. Maybe it is that engineers came then to be regarded as the people that would make a country strong and inconquerable and if worst came to worst, at least after the war technical people would rebuild their non-tecnical countrymen's lives; skills counted more than money. On the other hand businessmen would be associated with wartime profiteering, graft and de facto collaborating with the enemy, in exploiting fellow countrymen.

Last but not least, there's your attitudes to immigrant professionals.

I agree that there exists a very peculiar inferiority complex towards foreign ideas and products. While some specialists are being hired from abroad and given very good conditions, there are also scores of immigrants that got residence visas on the basis of a points system, planning to find a suitable position after coming here permanently (after being assured by NZ government publications, NZ embassy employees and various NZ immigration consultants that this country is in a dire need of 'specialists'), but didn't. I am one of them. During my six years of stay I have not been able to get any sort of a position approximating my skills, and my own consulting company does not bring me any income that I would call 'remotely acceptable'.

It seems that the only foreigners good enough to work here are those that signed their employment contracts while still in their home countries. All others immigrating to NZ within the scheme, supposedly targeting the world's 'best of the best' end up facing hostile and openly discriminating people, insolent in their ignorance and having no honour or dignity to admit that business degree gives no qualifications to assess professional skills (especially so advanced).

I have seen an advertisement for a car mechanic, reading approximately 'We service imported European top class models like Mercedes, BMW, Volvo and SAAB: because of the very high technology involved only candidates with NZ, Australian and British qualifications will be considered'! Surely nobody will claim any reason behind the claim that some foreigners from far-off countries, that did not progress much beyond sheep herding, shearing and butchering, (this is how Australasia is viewed in advanced countries) are better skilled than people educated perhaps by the manufacturer, qualified for employment at the manufacturing plant or to service and repair the products?

Your correspondent was distinctively lucky that his overseas employers never tried to settle in Australasia, as application of your 'criteria of professional assessment' would ensure he would have a difficult time progressing beyond a menial job. How for example would he deal with the arguments like "you don't know the society", "the names of subjects you passed, when translated word-by-word, are different from ours, hence your qualifications are non-recognizable in our country", "you have not been working here, so you have no experience", "you are overqualified for this position, perhaps you should hide some of your knowledge and apply for an entry-level job" (position applied for was much higher than entry-level), or "you should do your studies anew and begin like everybody else — we don't like anybody trying to be different"?

I can only say that people like Curie-Sklodowska, Einstein, Rutherford or Feynman started their scientific careers in normal countries, straight after studies where they had just gained doctorate degrees and, according to your 'system', were no geniuses (as they had nothing to show), so most probably would be expected to be happy when offered a job of emptying garbage cans in the Institute of Physics. SHAME!

I am for example very bad in such low jobs, but good on advanced scientific and managerial positions. So according to your 'system' I have very slim chances of finding a position matching my skills and experience. This invention of a severely sick mind might work with immigrants who lied about their skills and experiences, building themselves impressive careers without a grain of truth, but not with honest people.

I really do hope that 'Electronics Australia' will put its very considerable weight behind this widespread and very shameful problem.

Well, there you are. It's pretty hard-hitting, and quite scathing about some of the undeniable shortcomings that apply in many industries in Australia and New Zealand — not just the electronics industry. My thanks to Mr Frankowski for contributing so forcefully to our discussion, and I hope many of the points he has raised will set other readers thinking.

It certainly seems that European countries like Poland, Sweden and Germany treat their scientists, engineers and technicians rather more equitably than they're treated over here. Could this have something to do with the fact that their technical manufacturing industries seem to be more dynamic and expanding than ours?

I'll leave you pondering *that* thought until next month. Let me know your reactions to what Mr Frankowski and our other contributors have written. ❖

NEW BOOKS

Internet guide

THE REALLY EASY GUIDE TO THE INTERNET, for Australia and New Zealand, by Alan Ford. Published by Hodder & Stoughton, 1996. Soft covers, 244 x 182mm, 278 pages. ISBN 0-7336-0391-2. RRP $29.95.

Not *another* book about the Internet, I hear you ask? There's so much nowadays about it in the media, but most of it is either such superficial hype or so laden with jargon that it's quite off-putting even to many of us already using the Net — let alone those still trying to work out whether or not they could make use of it. This new book by local engineer and author Alan Ford is written specifically to provide an easy to understand and accessible introduction, not only to the Net itself but how it's used for various purposes.

There are 12 chapters in all, covering all of the main aspects of Net usage (mainly via the Web browser Netscape) — including e-mail, Web 'surfing', using search engines, newsgroups, IRCs and earlier tools like FTP, Gopher, Archie and Veronica. There are also six appendices covering telecommunciations basics, 'smileys', chatronyms, domain and country names, Internet service providers in Australia and NZ, and a glossary of terms.

It's all written in easy to understand language, takes a gentle step-by-step approach and the text is well supported by numerous screen grabs and other illustrations. Unlike most other books on the Net it's also slanted specifically towards the reader in *this* part of the world, too — which should help the local newcomer to feel 'at home'.

In short, a book which would be a good choice for the Net beginner. That front cover is a bit garish, though...

The review copy came from Hodder Headline Australia, 10-16 South Street, Rydalmere 2116. (J.R.)

Using op-amps

LINEAR ICS AND APPLICATIONS, by A. Postula and L.C. Jain. Published by BPB Publications, 1994. Soft covers, 175 x 235mm, 220 pages. ISBN 81-7029-437-1. RRP $17.95.

This book is mainly about op-amps, but includes a few related linear ICs such as the XR2208 four-quadrant multiplier, the Intersil 8038 waveform generator IC and one or two others. The book is from the New Delhi publisher BPB Publications, and like others in the series is budget priced. This one however shows its low price more than the others I've reviewed, with drawings sometimes hand corrected, often misaligned and of varying quality.

Despite this it has a lot of useful information, and covers a wide range of topics. It starts with a chapter describing the internals of the 741 op-amp, a bipolar transistor-based device. The next two chapters deal with the internal circuitry of MOSFET and MESFET op-amps. If you haven't heard of a MESFET, don't worry, the authors go to great lengths describing this gallium arsenide (GaAs) device and how this technology can be used in an op-amp.

Another chapter compares the ideal characteristics of an op-amp to those of a 'real' op-amp. The rest of the book is on op-amp applications, starting with basic amplifier configurations, the integrator and differentiator.

The authors have used a mathematical approach in most areas, and give numerous tables, graphs and circuits. The explanations are short and punctuated by equations, so if you are not mathematically inclined, your understanding of op-amps may not be helped much.

The review copy came from Jaycar Electronics, and is available from your nearest Jaycar store, catalog number BM2489. (P.P.)

Boat electronics

DAVE JEANES' MARINE ELECTRONICS MANUAL, by Dave Jeanes. Third edition, published by Oceanspan Books, 1996. Soft covers (comb bound), 210 x 150mm, 284 pages. ISBN 0-646-29489-X. RRP $30 including postage.

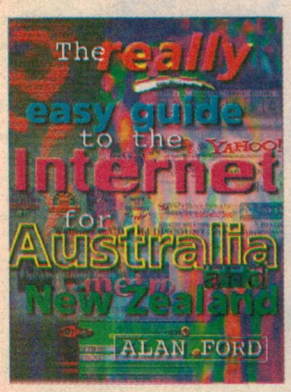
Another book from local engineer and writer Dave Jeanes, and like the last one 'all his own work' — written and laid out on the desktop using MS Word and Publisher, and then printed and bound at his local photocopy shop. He's getting pretty good at it now, too — the overall production quality is quite a bit better.

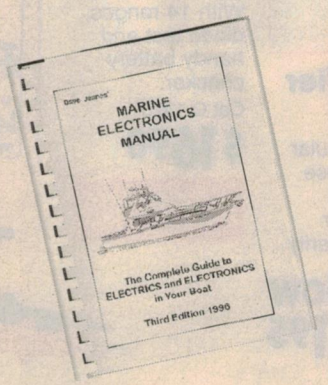
As the title conveys, this one is about boat electrics and electronics — which should make it of considerable interest, judging by how many Australians are keen on boating. There just aren't too many books on this particular area of electronics, either, which is presumably why Mr Jeanes has produced it.

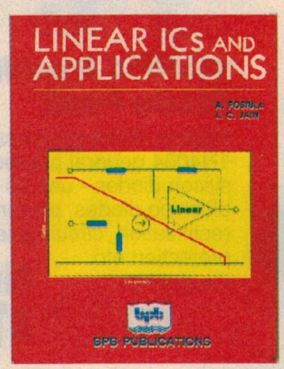
There are 19 chapters in all, starting with electrical fundamentals and progressing through other basics such as wiring, lighting, batteries and charging, through to system-level topics such as refrigeration, air conditioning, auto pilots, depth sounders, radars, navigation and communications. There's a good basic coverage of GPS, radio wave propagation, antennas, the GMDSS (Global Maritime Distress & Safety System), EPIRBs and other emergency equipment.

In short, a very practical and informative little book on most aspects of marine electronics, and one that should be found quite valuable by just about any boatie.

The review copy came from the author/publisher at Oceanspan Books, PO Box 303, Banora Point 2486 (phone/fax 0755 247 601, or e-mail at **deejay@coolgold.com.au**), and he's supplying it only by mail order. (J.R.) ❖







DICK SMITH ELECTRONICS

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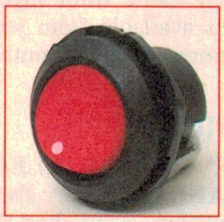

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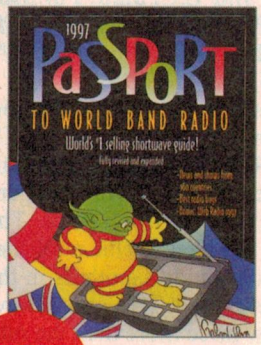

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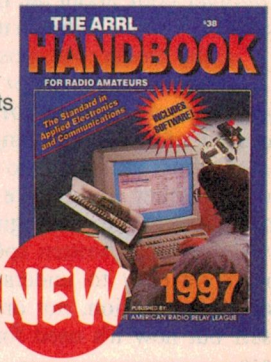

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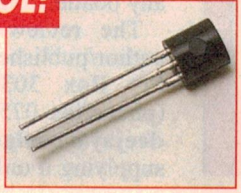

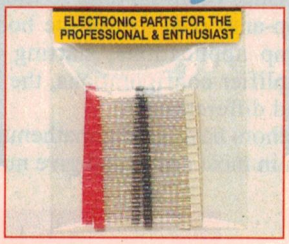

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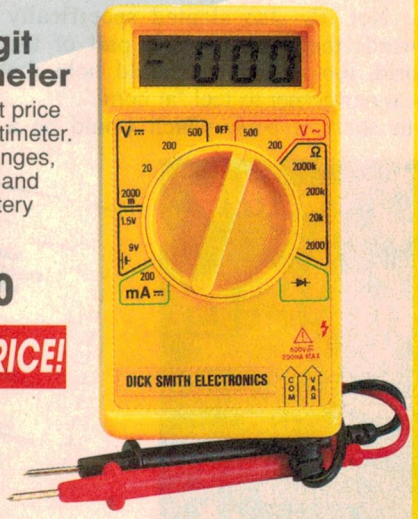

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Cat K 4216 EA Mar '97 **$22.50**

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Cat K 7348 **$99** EA Mar '97

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This smoke alarm control panel will power and monitor up to 10 smoke detectors. It provides a neat solution to the problem of using multiple smoke detectors throughout your house. Features include mains power operation with 12 volt battery backup and flashing LED power indication in each smoke detector. All alarms activated when one smoke sensor is triggered. Kit is supplied complete with all components, hardware, PCB, case, pre-punched screened front panel, battery backup and 5 smoke detector PCBs with components. Smoke detector not included

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SILICON CHIP Jan '97

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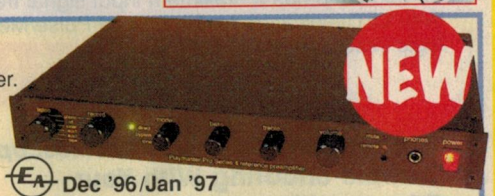

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- ☑ Gold RCA connectors
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Performance Data

Frequency response
(line inputs, typical load)
Direct mode: Unrestricted
Bypass mode: 15Hz to 30kHz + 0/-1dB
Tone mode: 20Hz to 20kHz +/-1dB with controls set to 'flat'

Total harmonic distortion
(20kHz bandwidth, typical load, at 1VRMS output)
Direct mode: Unmeasurable
Bypass mode: Less than 0.002%
Tone mode: Less than 0.002%
Input and output levels

Input and output levels
(Volume control at maximum, line inputs)
Direct mode: 1V in for 1V out (max output: unrestricted)
Bypass mode: 240mV in for 1V out (max output: 7V RMS)
Tone mode: 240mV in for 1V out (max output: 7V RMS)

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

Huge Savings!

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SPECIFICATIONS:

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Accuracy:	+/-3% +2Hz
Output impedance:	470 – 1100 ohms unbalanced
Output control:	0, –20dB, –40dB approx. plus fine adjustment

Cat Q 1310

SAVE $50 **$249**

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SPECIFICATIONS:

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Cat Q 1312

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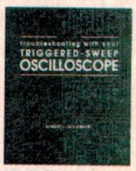
Get The Most From Your Oscilloscope

Trouble Shooting With Your Triggered-Sweep Oscilloscopes



The definitive guide to getting the most from your oscilloscope.
B 4801

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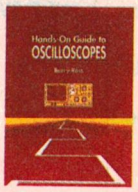
Hands-on guide to oscilloscopes



This hand book covers all aspects of oscilloscope use from basic operation to advanced functions. Ideal for electronic enthusiasts to electrical engineers.
B 4803

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20 MHz CRO

An affordable 20MHz oscilloscope that's suitable for a wide range of applications. It's a dual trace, dual trigger CRO with a fully adjustable sweep time (in 20 steps), variable hold-off, fully adjustable sensitivity, switch selectable X-Y operation, selectable trigger modes, AC/TV H/TV V trigger coupling, front-panel variable trace rotation and a sweep rate from 10nS/DIV to 1S/DIV.
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Dual Timebase

Full Featured 20MHz CRO

The perfect choice for design, fault finding and repair applications. Features include a beam-finder to bring the trace pattern back onto the screen, dual time base for accurate timing measurements, switch selectable X-Y axis, variable hold-off time and sweep magnification (x10) allowing extended sweep speed up to 10ns/div. Also has an adjustable illuminated grid and an inbuilt component tester for capacitors, inductors, transistors, etc. Complete with two probes.
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With Component Tester!

60 MHz Dual Timebase CRO

An essential tool for anyone working on CB radios, high frequency transceivers and high speed computers. Dual timebase can make more accurate timing measurements and you can compare portions of a signal at two different sweep speeds. You also get jitter-free triggering of delay sweeps. The beam-finder allows you to find the trace on the screen at the touch of a button. Additionally, you can test capacitors, inductors, diodes, transistors, zeners, etc easily and quickly. Complete with two probes.
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Universal CRO Probes

Universal probes with wandering earth leads and insulated shrouds. Both come complete with a handy pouch.

	60 MHz Probe	100 MHz Probe
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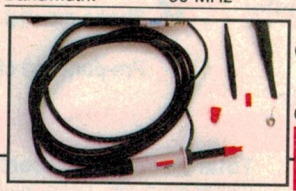
Input Capacitance:	170pF (x1), 27 pF (x10)	150pF (x1), 18 pF (x10)
Input resistance:	9M ohm (x10)	9M ohm (x10)
Bandwidth:	60 MHz	100 MHz



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Includes:
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3 Phillips heads (00, 0, 1),
3 hex bar drivers (1.5, 2.0, 2.5mm).

Complete with plastic storage case.

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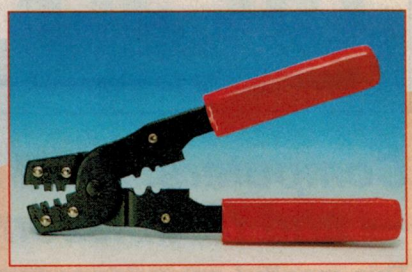

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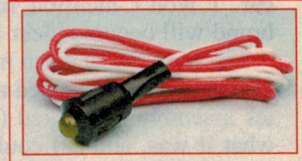

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STORES ACROSS AUSTRALIA AND NEW ZEALAND

THE SERVICEMAN

Computers, fixed and mobile — and troublesome QC inspection stickers!

This month I am going to feature stories about computers and their servicing. There are several of these stories that have come in over the last year or so and, since they are a little out of the usual run of servicing yarns, I have put them aside until I could find an excuse to use them *en masse*. Now that time has come, and on top of the list is a personal tale that gets up my nose every time I look at it.

We all know that really top of the line Pentium and similar microprocessor chips can cost up to $1000 each, and that sort of price is justified for mega-performance computers. But run-of-the-mill domestic type micro's are adequate for all sorts of mundane processes and these can cost as little as $3 each!

Which leads me to pose the question: how can auto manufacturers rate their quite average computers over and above the best of the super hi-tech computers from Intel and others?

This introduces a story that arose from a meeting at my local service station some time ago. The details of this particular story have been sitting in my computer for more than a year. I have hesitated to use it until now as I don't like to unduly criticise manufacturers. But I keep hearing the same or similar stories from other people, so at last I feel I should tell it as I saw it. It probably won't stop the ripoff but at least, it will let people know how they are being ripped off.

It concerns an engine management computer from a well-known brand of car. I won't mention names, but the brand will become clear later.

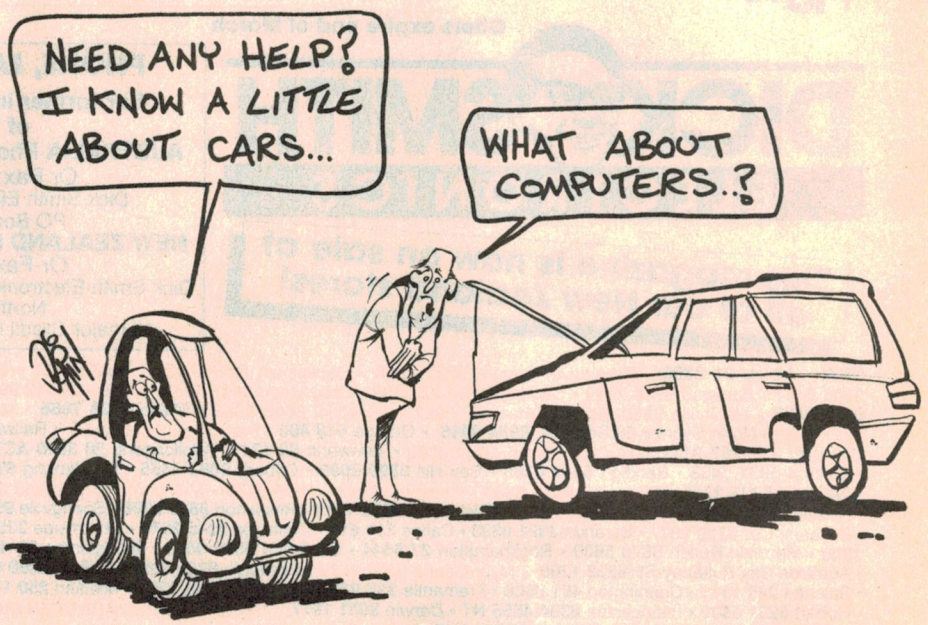
The story began when my local service station mechanic handed me an electronics assembly and asked (1) did I know what it was, and (2) could I fix it. The answers were yes, and I don't know.

It was obviously a computer of some sort, and I guessed it to be an engine management computer. However, I couldn't offer to fix it because I didn't know what was wrong with it, and all the parts were bereft of part numbers...

The owner of the unit was standing alongside the mechanic and he asked me if I would hazard a guess at the cost of the computer. I could identify the types of components involved and put a price on readily available equivalents. I pointed out that the components might be special types or of critical tolerance, which could affect their cash value. But on the face of it, I would value all of the parts needed to make this computer at about $50.

The owner was most upset at this news because, he said, he had just been charged $1200 for a replacement computer. He went on to explain that the computer in my hands was usually faultless, except that sometimes it went crazy and stalled his car, often in the most inconvenient places. It was a typical intermittent, well known to all and sundry in the TV and VCR service industry.

I examined the unit carefully and actually found the fault — a dry joint on a long connector strip. Unfortunately, the construction of the unit was such that the joint was inac-



cessible without dismantling a complicated plastic support bracket.

Trying to resolder the joint in situ would have destroyed, or at least badly distorted the support bracket, so disassembly was the only course open. But then reassembling the computer and bracket would have necessitated an assembly jig, which I didn't have.

So, we concluded that the computer could have been repaired quickly and easily by anyone with access to the proper jig (or the skill to make their own!)

But that's not the end of the story. The owner paid over his $1200 and asked for the old computer — he intended to give it to his son to play with. He was told that the old computer had been dumped in the bin and that it was 'not company policy' to return faulty parts to the owner.

This owner was not so easily put off and threatened all kinds of legal action if he did not get his faulty parts. The old computer was eventually handed over, reluctantly, and with much grumbling and unpleasantness.

It was only later, when the owner was showing the computer to my mechanic friend and I that we noticed the label on the casing. It stated 'Engine Management Computer — reconditioned by Delco for General Motors'.

The car was only 13 months old — just out of warranty — and the owner had been asked to pay $1200 to replace a computer that wasn't even new in the first place!

After seeing that label, we knew why the service department was reluctant to return the 'faulty' computer. 15 minutes on the bench and they could sell it again, for another $1200.

It might be unfair to accuse the car manufacturer of fitting a reconditioned part in a new car, because we don't know the history of the car between the factory and the showroom floor. However, the owner is adamant that the computer had not been changed since the car left the showroom. So somebody was pulling a swifty and, as usual, the 'poor bloody public' was paying for it.

Personally, I'm going to stay with my (non-electronic) 1973 Datsun clunker. At least I can fix that with a hammer and fencing wire!

Hi-tech intermittent

People who use computers are not usually un-intelligent people, but they are often technologically immature folk. Put another way, they know what they want, even if they don't know how to get it.

Our next story is again one of unsatisfactory treatment of clients by computer manufacturers and/or distributors.

This story comes from John Walsh and tells about his struggles to overcome faults that would never have occurred if the dealers and earlier servicemen had done their jobs properly:

A job came up recently which helped to tune up my 'hands on' skills, which have until recently been sidelined by management responsibilities. It came about due to a recent change in career direction — which meant that I was out looking for work instead of having it brought to me.

This particular job highlighted some of the deficiencies in the support services available to personal computer owners when non-routine problems arise.

The enquiry came from a small business for which it was essential to have access to CD-ROM and modem dialup connections for collecting data, as well as the usual computer functions for their routine office requirements of word processing, spreadsheets and client database information.

They had reached an impasse with the supplier of the computer who, over a period of some months, had repaired the equipment only to have it fail not too much later — after the case had been buttoned up and everybody had gone home.

The supplier was becoming increasingly difficult to contact. He was either not in the office, out on another job or "on the other line and will call back" (maybe sometime in the near future).

The PC was effectively the local server on a small office network. The installation was without any pretensions and should have been totally reliable. But in this case, its main feature was that it was totally UNreliable.

The first attempt at modem communications after boot-up was usually successful, but subsequent tries would crash the system.

Whenever it was necessary to use the modem, the system had to be switched off, then re-booted — after which it was OK for that modem session.

Besides all that, the CD-ROM had stopped functioning.

To add to the frustration, if the computer was powered down to wipe the slate clean and start from scratch, there was a more than even chance that it would not power up at all!

It was a real Catch 22 situation. If you powered the system down to clear the modem problem, there was a good chance it wouldn't power back up anyway. How's that for a bag of problems, in a computer with slightly more than a year on the clock?

What it had come down to was the supplier was reluctant to provide any more support on the computer, and the customer was in no way satisfied because it had become a lottery as to whether it was going to behave or wander off into the great vacuum of '$%#@&^*($)' land...

My appearance on the scene was a little unnerving, in particular because initial tests involving the removal of various interface cards (in an attempt to localise the faults) led to completely random results. Sometimes these

proved successful and at other times to be a total failure. The results were essentially inconclusive and certainly didn't lead to any organised analysis of likely causes of the problem or problems that existed.

The instant diagnosis was that there was a problem with the motherboard, either dry joints or poor contacts being the principal causes, and the process of removing and reinstalling the interface cards was aggravating the random responses. It was agreed that the computer be taken to the workshop, to allow closer investigation of the likely causes of the problems.

Given the random nature of behaviour, once setup I moved to the power supply, it being the low level 'engine room' of the whole computer. I wanted to find some clues as to why it was such an erratic starter. Experience has led me to believe that there is a good likelihood that if a circuit has worked in the past and is becoming intermittent, then a close inspection of the PCB is certainly warranted, particularly if the circuit is heat stressed — as is the power supply.

A quick clean of the circuit board to remove the flux residue left behind by the manufacturer, followed by a close inspection showed up a few suspect dry joints as well as some solder splashes which may have contributed to the problem. After re-soldering the joints, my luck must have been with me since the computer was now at least powering up reliably.

The next step was to inspect the motherboard, and this required that it be removed from the case. The board was mounted on a metal base plate, screwed onto the chassis rails on opposite sides with two screws on one side and four on the other.

It was immediately apparent that the side with the four screws wasn't attached to anything. The way the mounting plate and chassis rails were threaded, the screws on one side had to be inserted from the outside in, and on the other side had to be fitted from the inside out.

The screws from the inside of the case needed to be quite short so as not to foul the case cover when it was installed. These screws were too long and were fitted the wrong way round, leaving the mounting plate flapping in the breeze and supported on one side only. To correct this problem required not only the right length screws but also removing the floppy, hard and CD-ROM drives to get access to the screw holes from the inside...

A careful inspection of the motherboard and SMD chips yielded no likely dry joints or poorly soldered legs. But with the motherboard fitted to its mounting plate and the mounting plate fitted the way it was intended to be, the whole assembly was considerably more rigid.

The edge connectors on the peripherals (sound card, modem card and video card) were cleaned up and it was obvious on the sound card that one of the 'manufacturer's quality inspection' labels was laid partly over a connector finger and may well have been a cause of the CD-ROM problem. This was removed and the connector cleaned.

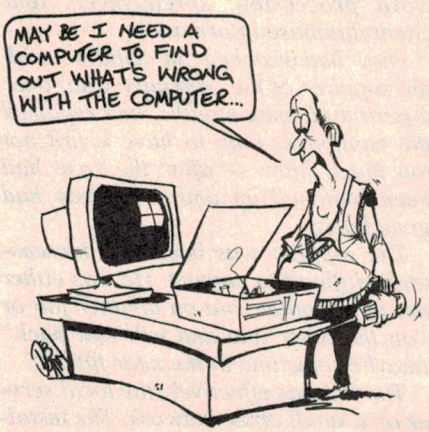
All this was taking much longer than I would have liked, but with everything reassembled things were happening. The computer was powering up reliably, the modem operating with various comms programs and the CD-ROM was functioning. Success? — well, almost.

I closed up the case and ran the system for several hours, all the while cycling it on and off without a single failure. Then I noticed that the power supply fan wasn't running!

The case and power supply were opened yet again and the fan was found to be seized; it required a replacement. Once this was done the job was considered finished — until I noticed that the CPU cooling fan was also not operating. This was removed and responded well to spray lubricant.

At long last the case was closed up and the job deemed to be complete. It has now been returned to service without any further problems.

Several points come out in reflecting on the progress of the repair. We don't know where the first mistake with the screws occurred. One would think that the manufacturer would have got it right, leaving the error in the hands of the first technician to service the machine. Had proper care been taken in the reassembly of the computer, then at least some of the problems may not have occurred...



The 'quality assurance' sticker most likely did little but impair the quality of the sound card, although it may have had a bearing on any of the other malfunctions. And finally there was the seizure of the two cooling fans. In talking to the client, I learned that they had resorted to leaving the computer permanently powered up, to overcome the likelihood of it failing to restart after it was switched off.

Information had been given to the client — which agrees with a range of current thinking — to the effect that computers can be left permanently powered up. This has also been the subject of discussion in recent EA correspondence. My own thinking is that this may well be true for hard disk drives and CD-ROM drives, but it may not be so for the bearings fitted to low cost power supply or CPU cooling fans.

Well, John, what can I say after that exercise, other than thanks for letting us know. I agree with you that it is likely that the manufacturer assembled the machine correctly. Which presumably leaves the first serviceman with four short screws that he has no need for...

I have often joked about having more screws left over after a job has been finished, than I removed during the earlier stages. However, no responsible operator would leave a job like that — even if, as in this case, the machine had to be stripped back to the bones to replace the surplus screws.

I agree with you, John, that the loose motherboard was probably the source of most of the faults. But as you'll see from our last story this month, that QC label may well have played a significant part in the litany of woes you have related.

Thanks for the story and we'll look forward to more of the same...

Lost track of time

Our next computer item comes from Eric Rodda, of Marion in South Australia. Eric has appeared in these pages a month or two back, with a TV repair story. But this time he has a computer tale to tell which fits nicely

with this month's theme. Here's what he has to say:

This story involves an IBM compatible 386DX computer that had a problem with time keeping. The 386 operated perfectly except for the fact that the clock on the motherboard refused to run whenever the power was turned off.

There's a battery in the IBM style computer which does two things: it powers the clock to supply the date and time, and it retains configuation information regarding floppy discs/hard drives, memory and video diplay type etc., by supplying power to a CMOS RAM chip.

Oddly enough, the configuration data in this particular computer was always correct. So although I suspected the battery, I couldn't imagine how it could do one job but not the other.

Access to the battery was easy once the top cover had been removed. It consisted of a three-cell (60mAh) NiCad pack soldered to the rear of the motherboard.

The battery read only 2.5 volts instead of at least 3.6V. It seemed as though one cell had gone short circuit. Apparently the CMOS RAM functions adequately on 2.5V or less, while the clock requires the full 3.6V.

The faulty battery was removed quite easily from the top of the motherboard, with a soldering iron applied to each end alternately. A replacement battery was purchased and installed, the CMOS setup performed and the date and time set. The next time the computer was used everything was working fine — correct date and time.

Thanks for that one, Eric. It's something to think about next time the PC won't boot up. It doesn't have to be a software or hard drive failure, does it?

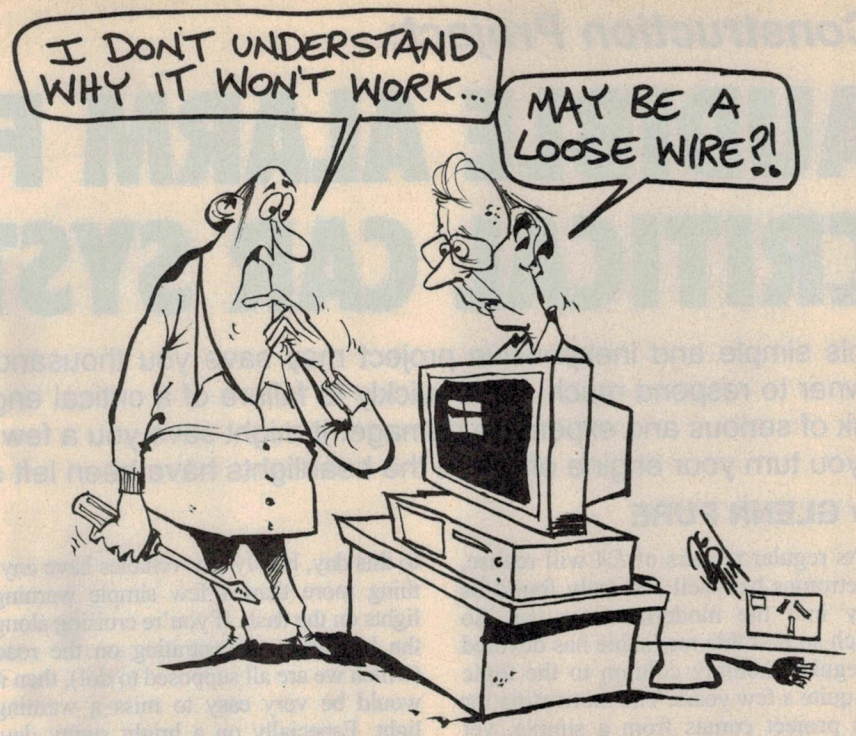
Clockless microwave

The next story is not quite a computer problem, although it does concern a microprocessor and computer-type functions. It comes from Peter Smith, of Kenmore in Queensland, and concerns the family microwave oven.

I've always enjoyed reading the Serviceman, so here is a note which might be of interest.

The other day, the power dropped out (nothing serious, just a damp electric kettle socket — when is someone going to solve that one?), so then everything in the house had to be reprogrammed.

I started with the microwave, a National Dimension 4 which we had purchased in 1985. Of course, the oven refuses to do anything else if it doesn't know the time, so my first job was to set up the clock. I pressed 'CLOCK', but got no response. I tried again, with the same result.



Then I did what I should have done first. I got out the manual and reviewed the procedure, then tried yet again! I turned everything off and tried again. No result; pressed 'CLOCK' even harder; no result! Wriggled the 'CLOCK' button. Nothing seemed to work. Since we use the microwave for most of our meals, we clearly had a problem.

Now my wife thinks engineers can fix anything: "It's just a computer in there, why don't you look at it?" All I know about microwave circuitry is that if you don't know what you are doing you can fry someone's brains; so we called our friendly local Serviceman.

He diagnosed a bad panel, and said that a new one could cost about $150. And what with his time and the fact that there were sure to be other things wrong with an 11-year-old microwave, it wasn't worth the bother. He suggested that we should junk it and buy a new one. It seemed like sensible advice, so the old oven sat there in the garage for a couple of weeks.

Then I thought — if it was going to be junked, I might as well take look at it. You never know, I might learn something.

It was surprisingly easy to pull apart (compared to the average computer), and I had the front panel out without having to touch any of the mysterious (and quite likely dangerous) bits inside. Though I did think to make a diagram of all the connections, before I committed myself...

So there I was with this thin panel, with the controls printed on the front, a ribbon cable coming out the side and a little QC inspector's label stuck on the back. There didn't seem to be much else that I could do.

Then I noticed that the inspection label was positioned almost directly behind the 'CLOCK' control, with one edge of the label right in the middle of the control. These thin-film pressure contacts can be funny beasts, so I carefully scraped off the label with my calibrated thumbnail and removed the remaining adhesive. (Incidentally, butter is great for dissolving that goo.)

Everything went back together easily, and it worked first try!

I had heard about the fatigue crack that started at the inspector's stamp, but this is a new one on me. My wife is now even more convinced that engineers can fix anything — if they want to.

Thanks Peter, for that little item. As John Walsh found earlier, and you have uncovered here, QC labels can cause all kinds of trouble.

I once found a label stuck over a PCB pad that was supposed to be in contact with a mounting screw, as a backup earth return. The product failed when the primary earth link came adrift, and it took me a long time to work out that the label was stopping the backup link from doing its job. Wouldn't you think that manufacturers would be alert to that sort of potential problem?

Anyway thanks for that story, Peter. It's a nice one to end up on this month. ❖

Construction Project:

AUDIBLE ALARM FOR CRITICAL CAR SYSTEMS

This simple and inexpensive project may save you thousands of dollars. It will allow any car owner to respond much more quickly to failure of a critical engine system, thereby reducing the risk of serious and expensive damage. It might save you a few car batteries too, as it also beeps if you turn your engine off when the headlights have been left on...

by GLENN PURE

As regular readers of *EA* will realise, electronics has well and truly found its way into the modern motor car. So much so that this magazine has devoted a regular monthly column to the topic for quite a few years. The motivation for this project comes from a simple, yet serious weakness that still persists in most of these systems.

Virtually every vehicle manufactured has instruments to enable the driver to monitor key vehicle and engine operating parameters. Some, like the speedo, are critical for staying within the law and avoiding a 'ticket to the policemens ball'. Others are essential for safety, like brake warning systems. Yet others are critical to your wallet — the ones that tell you about impending failure of your engine. For example, loss of oil pressure at high speed can destroy an engine in a very short time — measured in seconds, not minutes.

It is absolutely essential to respond to engine warning systems very quickly. Yet to this day, hardly any vehicles have anything more than a few simple warning lights on the dash. If you're cruising along the highway, concentrating on the road (which we are all supposed to do!), then it would be very easy to miss a warning light. Especially on a bright sunny day, when a light is that much harder to notice.

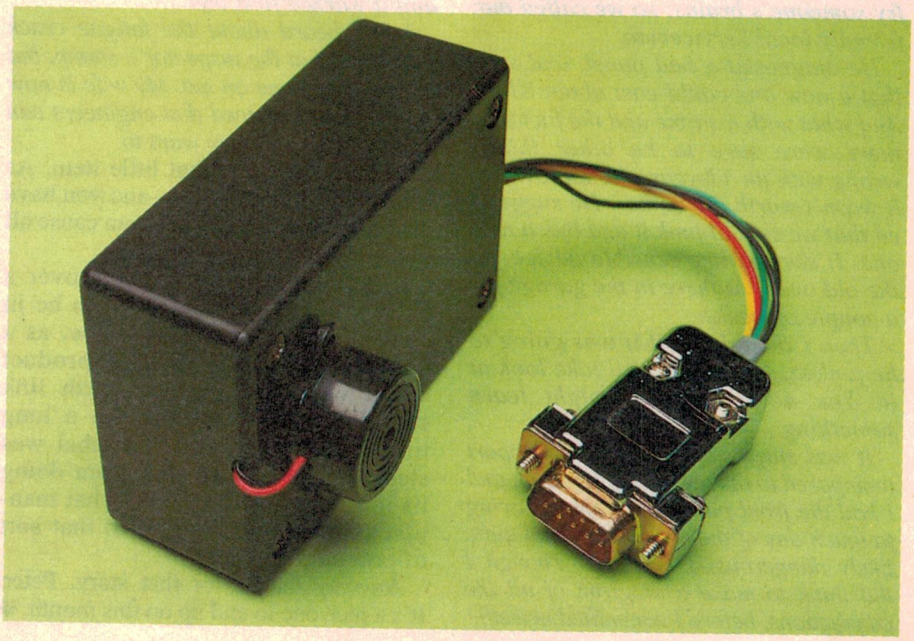
There is evidence to support the existence of a problem. A check with a Canberra engine reconditioner indicated the main source of his business is overheated engines. However, be warned that many engine temperature sensors are set into the coolant jacket and when this runs out, the sensor can sometimes fail to detect a dangerously overheated engine. So check your engine coolant level regularly!

Interestingly the other main cause of damage is failure to change engine oil at proper intervals. An engine that wears out from old age is a rare beast indeed...

Of course, vehicle makers know all of this. Conspiracy theorists would argue the omission of more effective warning systems is simply a careful strategy to keep makers in the spare parts business. Maybe it's just sad reality that the inclusion of such features simply isn't a selling point, so a fiercely competitive market which demands that costs be minimised means that such features are not included.

Whatever the reason, this project will allow you to take charge and correct the deficiency. A dim light hidden in an obscure recess on the dash is a lot easier to miss than an audible warning beep. No matter what you are concentrating on, you will be immediately aware that you should check the dash without delay.

The circuit can also easily interface to the solid state audio recorder project (*EA*, February 1995) so instead of a beep, you can replay a recorded message which tells you exactly what the problem is, and maybe even what to do about it.



All of the monitor circuitry fits in a very small plastic utility box, which can be mounted easily under the dashboard.

The circuit

The design has been kept as small and simple as possible, involving only three fairly common ICs and a handful of discrete components. Fig.1 shows the schematic.

The circuit is designed to generate a short-duration beep (about eight seconds) when an engine fault state is detected, or if the headlights are left on when the ignition is switched off. In summary, it consists of a quad comparator as an input signal processor. This generates high or low level outputs that are processed through some simple logic and are then buffered and passed through a timing circuit, to ultimately drive a piezo beeper.

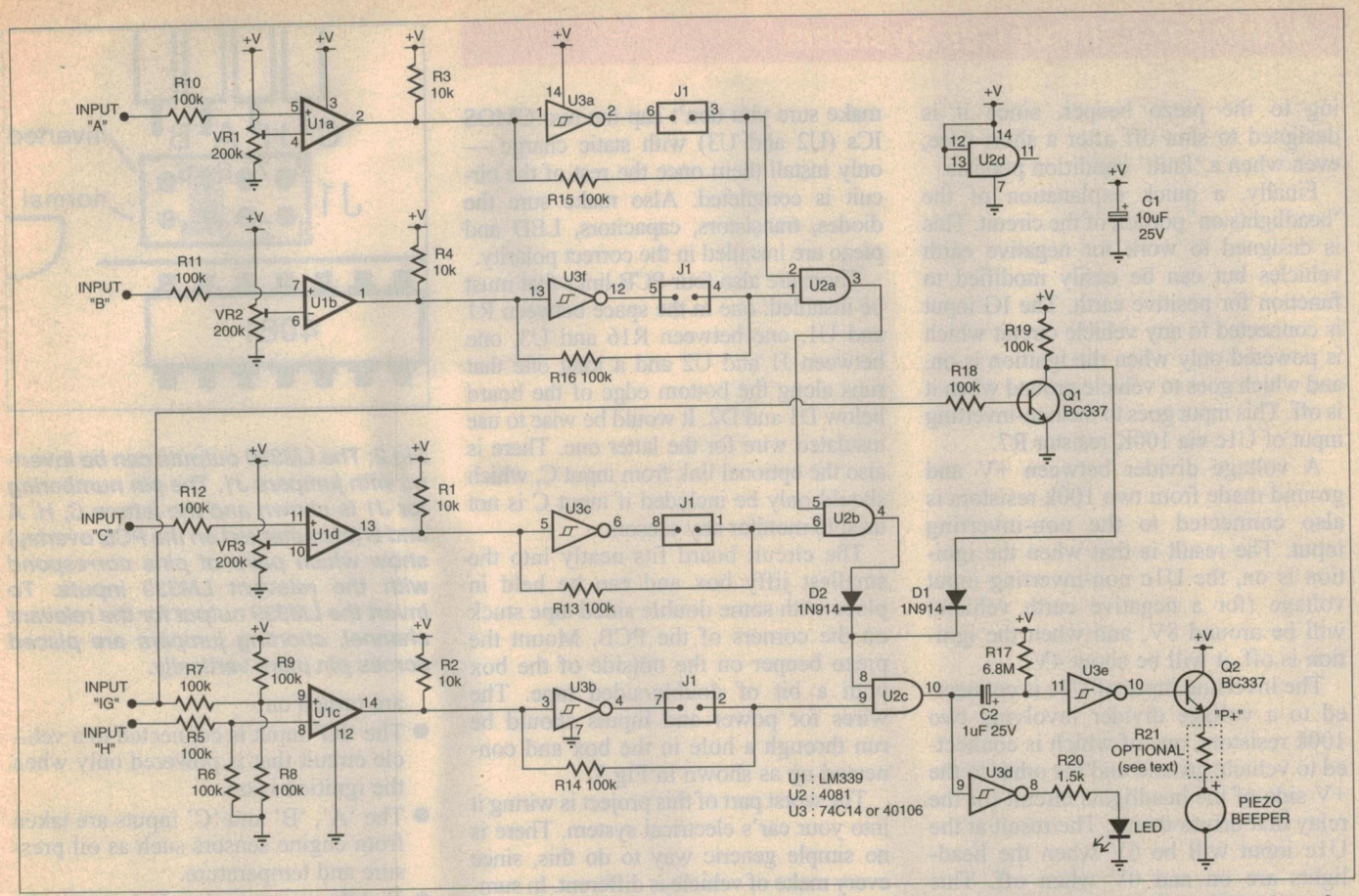


Fig.1: As you can see from the schematic, the monitor uses only three low-cost ICs. As well as monitoring critical engine status it also warns if the headlights have been left on when the engine is stopped.

The description below is for negative earth vehicles but the circuit can easily be modified for much rarer positive earth types. It must be powered all the time — even when the vehicle ignition is off. But it will typically only draw about 5-10 milliamps which should be nothing to worry about, even if your vehicle is left idle for months.

Starting with the inputs (A, B, C, IG and H), these go to the LM339 quad comparator (U1). One comparator is used as a 'headlights on' monitor. The other three can be configured to monitor any sensor that outputs a voltage between 0 volts and the battery supply. There is no reason to use all the inputs, but please remember to tie any that aren't used to +V or ground, to eliminate potential oscillation. I have only included an optional link to ground for input C on the PCB, figuring most people will want to use most of the inputs.

The three general purpose vehicle sensor inputs (A, B and C) are each processed through separate comparators in the LM339. More specifically, they each go to a non-inverting comparator input through 100kΩ resistors.

The inverting input of each of the three comparators above is connected to an adjustable voltage divider, formed with the 200k trimpots (VR1 to VR3). This allows the user to set the trigger voltage at which the comparator will switch its output high or low. Note that VR1 corresponds to input A, VR2 to input B and VR3 to input C.

On the output side, the LM339 has open collector outputs so there are 10k resistors (R1 to R4) as pull-ups.

If necessary, any of the comparator outputs can be inverted with the jumper links J1. Each of these jumpers simply enable an inverted signal produced by the Schmitt trigger inverters of U3, to mask the direct comparator output. The inverted version is selected by shorting a pair of pins on J1 (see Fig.2).

The signals then pass to 4081 AND gates (U2). A low level on any of the inputs of U2 causes the beeper to sound and therefore signals that a fault has been detected. A high level means all is OK. It is important to remember this, to understand the logic below.

The outputs of the LM339 corresponding to inputs A, B and C are 'ANDed' through U2a and U2b. The resultant output is then ORed with the diode logic OR gate formed by D1 and D2. The other input to this OR gate is a signal that stays high when the vehicle ignition is off (but which goes low when the ignition is on). The latter signal is generated with R18, R19 and transistor Q1. The purpose of all of this is to ensure that the output at the OR gate remain high (i.e., the 'no fault' state) when the ignition is off. No matter what signals go to the A, B and C inputs, they will be ignored when the ignition is off — i.e., the engine isn't running. This makes sense as these inputs monitor engine sensors.

The output of the OR gate is ANDed (U2c) with the signal from the headlight sensor, via input H and comparator U1c. The only time the output of the latter goes low is when the ignition is off and the headlights are still on. The output of U2c is fed to an inverting buffer, U3d, which drives a LED. The LED only lights when a fault condition is detected. The output of U2c also goes to the timing circuit formed with C2 and R17. The output of this is finally inverted once more (U3e) and used to drive the piezo beeper through Q2.

The LED is really just a convenience when installing the circuit. It will show you whether any fault conditions have been detected — i.e., whether any of the AND gate inputs are low. It is not always feasible to check this by listen-

ing to the piezo beeper, since it is designed to shut off after a short time, even when a 'fault' condition persists.

Finally, a quick explanation of the 'headlights on' portion of the circuit. This is designed to work for negative earth vehicles but can be easily modified to function for positive earth. The IG input is connected to any vehicle circuit which is powered only when the ignition is on, and which goes to vehicle ground when it is off. This input goes to the non-inverting input of U1c via 100K resistor R7.

A voltage divider between +V and ground made from two 100k resistors is also connected to the non-inverting input. The result is that when the ignition is on, the U1c non-inverting input voltage (for a negative earth vehicle) will be around 8V, and when the ignition is off, it will be about 4V.

The inverting input of U1c is connected to a voltage divider involving two 100k resistors, one of which is connected to vehicle ground and the other to the +V side of the headlights circuit (or the relay that drives them). The result at the U1c input will be 6V when the headlights are on and 0V when off. This means that the output of U1c will only go low when the ignition is off and the headlights are on.

The only part of the circuit I haven't mentioned is resistor R21. This is simply an attenuator for the piezo sound level. It is discussed in more detail under 'installation' below.

Assembly, installation

Assembling the circuit is straightforward. No special care is needed except to make sure you don't zap the two CMOS ICs (U2 and U3) with static charge — only install them once the rest of the circuit is completed. Also make sure the diodes, transistors, capacitors, LED and piezo are installed in the correct polarity.

There are also four PCB links that must be installed: one in the space between R1 and U1, one between R16 and U3, one between J1 and U2 and a long one that runs along the bottom edge of the board below D1 and D2. It would be wise to use insulated wire for the latter one. There is also the optional link from input C, which should only be included if input C is not used to monitor any sensors.

The circuit board fits neatly into the smallest jiffy box and can be held in place with some double sided tape stuck on the corners of the PCB. Mount the piezo beeper on the outside of the box with a bit of double-sided tape. The wires for power and inputs should be run through a hole in the box and connected up as shown in Fig.3.

The worst part of this project is wiring it into your car's electrical system. There is no simple generic way to do this, since every make of vehicle is different. In summary, this is what you need to achieve:

- Power for the circuit must be from a source that is live all the time, even while the vehicle's ignition is off. Because of this, it is easy to accidentally short during installation — so please first remove the fuse for the relevant circuit from the vehicle's fuse box.
- The 'H' input should be from a point that receives power when the headlights (or parking lights, if desired) are turned on.
- The 'IG' input is connected to a vehicle circuit that is powered only when the ignition is on.
- The 'A', 'B' and 'C' inputs are taken from engine sensors such as oil pressure and temperature.
- Finally, connect the -V input to the vehicle's ground (on negative earth vehicles).

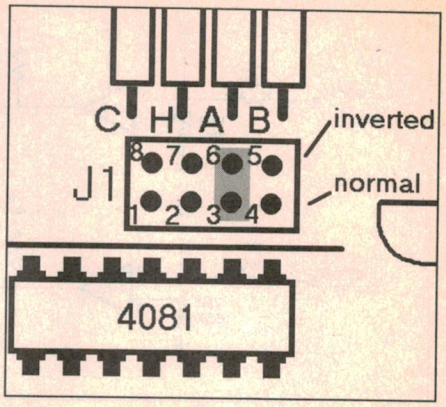


Fig.2: The LM339 outputs can be inverted with jumpers J1. The pin numbering for J1 is shown and the letters C, H, A and B (also marked on the PCB overlay) show which pairs of pins correspond with the relevant LM339 inputs. To invert the LM339 output for the relevant channel, shorting jumpers are placed across pin pairs vertically.

To give you an idea how to go about this, the process for my car was as follows. I took the power and 'H' inputs from the steering column, where the ignition switch and the headlight switch are located. These were easy to get at since the plastic shroud on my 1990 Nissan Pintara steering column is easily removed by undoing a couple of screws, leaving the switches and wiring clearly exposed. Another possibility for the power is the cigarette lighter, as this is usually powered on most vehicles when the ignition is off.

In the case of the engine sensor inputs, I only used inputs A and B. Input C was grounded, with the optional PCB link mentioned above (also visible in the photo of the circuit board). Input A was connected to the temperature sensor and B went to the oil pressure switch.

Because of the mess of wires under my dash, I found it a lot easier to connect these up where the wires actually connect to the sensors in the engine bay. I cut into the insulation and soldered extra wires on. (You may need to consult your owner's manual or workshop manual to find out where your engine sensors are located.) I ran the wires through a suitable port in the firewall,

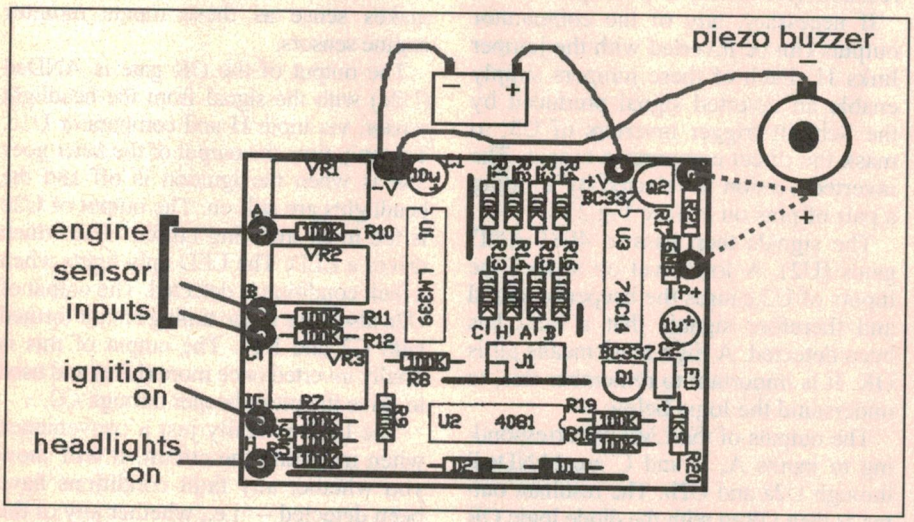


Fig.3: How the monitor's PCB is connected to the piezo buzzer, and also into the wiring of your vehicle.

then under the dash.

For those who don't want to bother soldering, there is an easy but potentially less reliable solution. Bosch kindly provided me with samples of their 'wire tap' product, which is an insulation piercing connector suitable for running an extra wire from an existing circuit. The Bosch part number is TH332 and most auto accessory outlets should have them. They seem to be effective, but if you use these connectors, be sure to tape them up well to avoid movement that might loosen their connection.

The wiring can be soldered straight onto the PCB board, or through an optional plug and socket. (I took the latter route and used a DB9 computer plug and socket, as they are simple and cheap.)

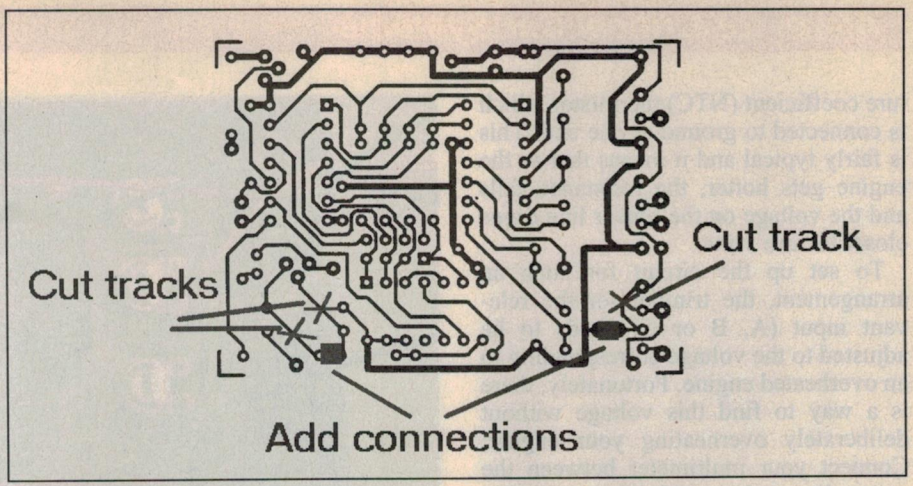


Fig.4: The modification to the PCB required for positive-earth vehicles. A total of three tracks need to be cut and two small shorting links installed.

Setting it up

Once everything is connected up, the next job is configuring the trimpots and J1 jumpers so that the unit works correctly. This should be fairly easy, but take care at this point otherwise it may not work when you most need it!

As already noted, an LED has been provided on the PCB to help set the circuit up. When the LED is lit, it indicates there is a fault condition that will sound the piezo beeper. During normal engine operation, the LED should always be extinguished and the piezo silent.

For the headlight sensor, provided the IG and H inputs are connected as outlined above, no link is needed on J1 for proper operation (on negative earth vehicles).

Assuming you use two of the general inputs (A and B) for engine temperature and oil pressure, the following information should help.

There are two main types of sensors. The first type simply consists of a switch that opens or closes when a fault is detected. The most common sensor of this type is the oil pressure switch. Most vehicles will have these; on my car, it was located right next to the oil filter. These normally close the switch when oil pressure is too low. On negative earth vehicles, switch closure (= fault condition) will normally ground the sensor line — i.e., send it to 0V.

Older vehicles will also have switching-type temperature sensors. These normally *open* when the temperature goes too high. You will need to check with your multimeter the voltage (12V or 0V) under normal and fault conditions. To simulate a fault condition, simply unplug the wire from the sensor, causing the circuit to go open.

To configure the project for operation with switching-type sensors, simply set the trimpot for the relevant input to the half-way mark (so it is supplying about 6V). You might also need to jumper the relevant pair of pins on J1, as follows.

If the switching sensor goes down to 0V (or to -12V for a positive earth vehicle) when a fault is detected, no inversion is needed and no jumper is required on J1. The reverse applies for sensors that switch high on detecting a fault. Note that the PCB overlay marks each pair of pins on J1 as they correspond to the circuit inputs (A, B, C and H/IG). Fig.2 provides more information on the use of J1.

The second type of sensor produces continuously varying output voltages. Such sensors include temperature sensors that drive a temperature gauge on the dash, and those that drive oil pressure gauges. My 1990 Nissan Pintara has such a temperature sensor — which is fairly typical for many later model vehicles.

In fact, on EFI vehicles such as the Pintara, there are usually *two* temperature sensors. One is for the engine computer and the other drives the gauge on the dash. The latter one should be used for this project, if possible. This will remove any risk of upsetting the temperature information that goes to your engine computer (although there should be minimal risk anyway, since the circuit has been designed with a high input impedance such that it should have negligible effect on any circuit to which it is connected).

The temperature sensor for the engine computer on my car can be distinguished because it has two wires connected to it while the sensor for the dash gauge has only one. However, other vehicles may be different, so please check.

There is an easy way to tell the difference. Simply warm the engine up, then disconnect one or the other to see what effect it has. Disconnection of the engine computer sensor will probably stall the engine, while disconnecting the sensor for the dash gauge will show up as a change on the gauge.

By the way, if you are wondering *where* these sensors are on your car, I found both of mine located next to each other and in a fairly logical place: screwed into a major water manifold on the engine, where one of the radiator hoses is connected. Hopefully, you will be as lucky.

The temperature sensor for the dash gauge on my car is a negative tempera-

PARTS LIST

Resistors

All 1/4 watt carbon unless stated otherwise:

R1-4	10k
R5-16, R18,R19	100k
R17	6.8M
R20	1.5k
R21	(1k suggested — see text)
VR1-3	200k 5mm horizontal mounting trim pots

(A 100 ohm resistor and a potentiometer — see text for value — is also needed, but only during circuit installation, and only for those who have temperature or oil pressure gauges in their vehicles that need to be monitored)

Capacitors

C1	10uF 25VW RB electrolytic
C2	1uF 25VW RB electrolytic

Semiconductors

2	BC337 (NPN) transistors
1	4081 quad two-input CMOS AND gate
1	LM339 quad comparator
1	74C14 or 40106 CMOS hex Schmitt trigger inverter
2	1N914 diodes or similar
1	3mm LED (any colour)

Miscellaneous

Small Jiffy box (83 x 53 x 47); mini piezo beeper (Jaycar catalog AB3462 or similar); PC board (60 x 45mm); light duty hook-up wire, assorted colours, 4 x 3m and 3 x 1m; 3 x 14-pin IC sockets; double sided tape; pin header, eight-pin in 2 x 4 configuration; 4 x pin header jumpers; tinned wire for PCB links.

ture coefficient (NTC) thermistor which is connected to ground at one end. This is fairly typical and it means that as the engine gets hotter, the resistance falls and the voltage on the sensor line drops closer to zero volts.

To set up the circuit for such an arrangement, the trimpot for the relevant input (A, B or C) needs to be adjusted to the voltage corresponding to an overheated engine. Fortunately, there is a way to find this voltage without deliberately overheating your engine: Connect your multimeter between the sensor line and ground. Also connect a potentiometer in series with a 100-ohm resistor between the sensor and ground. (The potentiometer value will depend on the nominal impedance of your car's temperature sensor — try one about two to four times the impedance at normal engine operating temperature. On my car, a 2kΩ pot did the job.)

With the ignition on and the temperature gauge functioning, slowly turn the potentiometer until the gauge on the dash is just registering an 'overheated' condition. Some guesswork may be needed to judge where the 'overheated' point is. Be careful to leave the gauge settle for 5 or 10 seconds, as these gauges usually have dampers on them. Now measure the voltage on your multimeter. On my car, it was around 4.4 volts, but will almost certainly be different on other vehicles.

I used input A on the circuit for my temperature input, so I then adjusted VR1 so its centre-lug output was registering 4.4V. Any voltage at input A that falls below 4.4V will mean the engine is overheated and cause the relevant output of the LM339 to go low. No link was therefore needed on J1 for channel A on my car.

Testing time

Now it's time to test the circuit. With the ignition off and the headlights off, the piezo should be silent and the LED off. Next, turn the ignition on — but don't actually start the engine yet. The piezo should sound and the LED come on since the circuit will have detected no oil pressure (the engine isn't running!).

Now start the engine. The piezo should quickly silence (if it hasn't already timed out) and the LED should similarly go out. Finally, try turning the headlights on while the engine is running. The LED should stay off and the piezo remain silent. Now turn off the ignition. The piezo will now sound until it times out (or you switch the lights off).

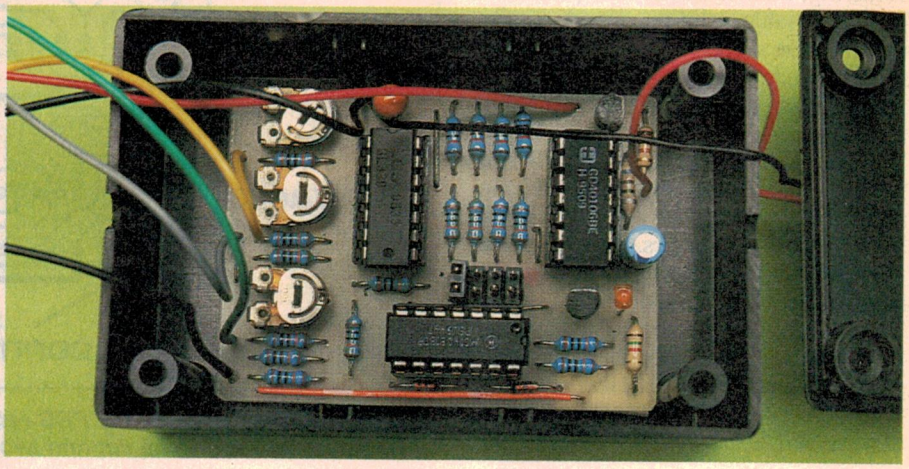
The circuit, in its jiffy box, should be finally lodged under the dash on the driver's side where it can be heard easily. A decent length of double-sided adhesive tape should be adequate to hold it in place and stop rattling.

Every time you start your car, you will know whether the circuit is working or not. It will give out a beep from the time the ignition goes on until the engine kicks over and the oil pressure rises to a safe level.

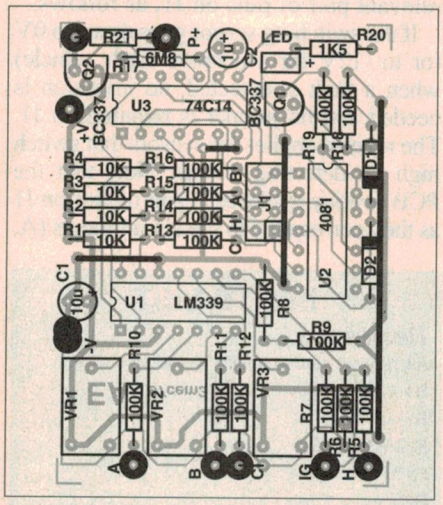
This could be potentially annoying, since the piezo is quite loud. That's why R21 has been included in the circuit, to reduce the piezo's output if you wish. I have used a 1kΩ resistor, which produces a comfortable sound level for my car. But if you want to be fussy, you could fit a pot, say about 5kΩ, and use this to adjust the volume.

For those who want to get really sophisticated, the piezo can be disconnected altogether and the circuit interfaced to the solid state audio recorder project (*EA* February 1995). By doing this it's possible to get a pre-recorded voice announcement about any fault condition. I haven't tried this myself, but interfacing should be very easy.

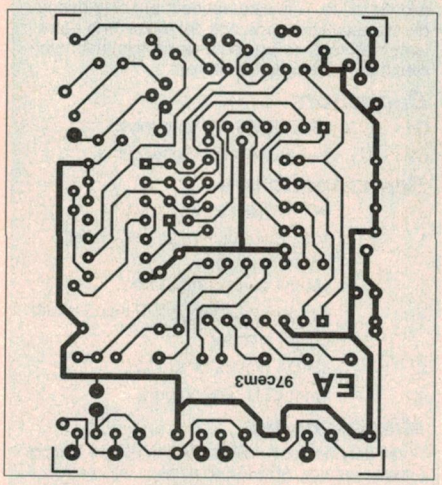
The signal needed to replay a message on the audio recorder can be taken directly from pins 5-8 of J1 and patched to four of the eight inputs of the audio recorder. Don't forget to ensure there is a common ground between the two circuits. You will also need to configure the bank of switches marked S2 on the audio recorder, which determines whether a high or a low on each of the inputs triggers replay.



A photo of the monitor PCB inside the case. Use it as a guide to wiring your unit, in conjunction with the overlay diagram below.



The overlay/wiring diagram for the engine monitor PCB, showing the location and orientation of all components.



And finally, here is the PCB etching pattern, as usual reproduced actual size for the benefit of those who like to etch their own.

Continued on page 79

SHORTWAVE LISTENING

with Arthur Cushen, MBE

Radio Canada scheduled to close

Radio Canada International in Montreal is scheduled to close on March 31 as the Canadian Government will not provide the budget of $16 million required to continue operation. This was the case last year, but worldwide pressure forced the Government to alter its decision. However, at the time of writing the closure finally seems imminent.

Over the years Radio Canada International has had a battle to get its budget passed by Parliament. From its founding in 1945 to 1991 it was funded by the Canadian Broadcasting Corporation, the domestic network, but from 1991 the Minister of Foreign Affairs took over the operation of RCI and since then there has been continual uncertainty as to the RCI budget. This must leave the staff in a very depressed state, with uncertainty facing them at the end of March each year.

Canada has been interested in shortwave broadcasting since the early 1940s, when the CBC operated a 7500W transmitter from Vercheres, Quebec to service mainly the northern territories of Canada. It was obvious during the war years that Canada needed an external voice and with assistance from BBC engineers three 50kW transmitters were installed in Sackville, New Brunswick. My files show correspondence from Jack Acton who came to Montreal from BBC London, to get the service in operation. He asked me to report on test transmissions, and since then I have been monitoring RCI frequencies five days a week over these past 51 years.

Canada began international shortwave broadcasting in 1945, as a service to Canadian soldiers in European theatres of war. Later, broadcasts were beamed to Czechoslovakia, France, Germany and the United Kingdom. By the late 1950s the international service was beaming its programmes to most of Western Europe, Latin America and the South Pacific in 16 languages. It did not, however, gain the name 'Radio Canada International' until 1972.

Even in those days, funding of Radio Canada was in doubt and in 1967 it was announced that Radio Canada would close. The budget then was $3,700,000 and the closure meant the end of employment for the staff of 207. In 1964 the Government had hinted at closure, and the outcry from the listeners and the Canadian public was such that the service was further expanded. A Royal Commission offered the Government advice on further expansion and new transmitters were constructed.

By 1972, the international service of the CBC became Radio Canada International and at the same time, three 250kW transmitters were put into service. There was rapid expansion of RCI in the following years with the introduction of several special services including for listeners, the Radio Canada Shortwave Club and Letterbox, and the future looked bright during the 1970s and 1980s.

In 1986 Radio Canada celebrated its 40th anniversary in Montreal, where I attended as guest speaker and it was also the 50th anniversary of the CBC. In 1991, there was a severe budget cut and many of the popular programmes were deleted; but nevertheless, RCI continued to prove a popular station with listeners worldwide. The budget cut resulted in 1100 staff members being laid off and a great majority of the programme services being taken from the Domestic CBC Networks in English and French.

Radio Canada became a focal point for international broadcasters who wished to reach an audience in North America, and so exchange agreements were made with Austria, Korea, Japan, BBC and other broadcasters to have a reciprocal agreement. For a period each day one carried the other's transmissions.

Recently Radio Canada has been using the following facilities: Kimjae, Korea; Sines, Portugal; Skelton, UK; Vienna, Austria; Wertachal, Germany; Xian, China and Yamata, Japan.

At the present time, listeners in the South Pacific enjoy four transmission periods 0200-0400 on 9755kHz; 0400-0430 on 9505 and 9645kHz; 0600-0630 Monday to Friday on 6050, 6150 and 9760kHz; and 2100-2200UTC on 9805, 11,945 and 13,650kHz. The Monday to Friday transmission is for Peace Keepers in Europe and Africa while the transmission at 2100 is for general listening in Europe.

The Minister of Heritage, the Honourable Sheila Copps, has commented in the House of Commons concerning the possible closure of RCI, but this will only reach finality on March 31. Only then will listeners find out if the worldwide protests at the closure have been successful and if a stay of execution has been achieved for this popular shortwave service. ❖

AROUND THE WORLD

ALGIERS: Radio Algiers International has a broadcast in English, 1600-1700 on 7145kHz, 9545, 9630, 15,205, 15,215, 15,595, 15,865 and 17,745kHz. News in English is at 1600 and after 1700 they continue in Spanish.

ETHIOPIA: Radio Farna in Addis Ababa, broadcasts 0330-0530 in local languages. It is also heard 1530-1730 and has been heard as late as 1930 on 6940kHz. The address of Radio Farna is: P.O. Box 30702, Addis Ababa, Ethiopia.

GUYANA: Voice of Guyana has been heard with weak signals at 0830 on 5950kHz, but is later blocked by WYFR.

IRAN: The Voice of the Islamic Republic of Iran (P.O. Box 19395-6767, Tehran, Iran) has been heard with English 1530-1630 UTC, with news at 1530; then political talks; news at 1615; then a travel talk, and complete schedule at sign off on 9635kHz.

IRELAND: RTE in Dublin broadcasts via WWCR on 5070kHz. The latest schedule shows RIFE in English 1000 Monday to Friday, and 1100 on Saturday and Sunday.

ITALY: RAI Rome broadcasts in English to Japan and is also heard in the South Pacific at 2200-2225 on 9565kHz replacing 9710kHz. It is also heard on 11,815kHz.

JORDAN: Amman has a classical music programme through to 1300, then news, and on Saturdays plays hits of the 1950s and 60s through to 1500 when there is a further news broadcast. This English transmission on 11,690kHz suffers some sideband interference during reception.

PARAGUAY: Radio Nacional, Asuncion on 9737kHz is heard with continuous Latin American music at 1000UTC, but with few announcements.

SOUTH AFRICA: The transmitting site at Meyerton, is being used by the BBC World Service at 1745UTC, when they have Sports Roundup and news at 1800 on the frequency of 9515kHz.

USA: KJES, which broadcasts from the Lords Ranch, New Mexico, has been heard at 1800UTC on 15,385kHz. WGTG, which operates from Copperhill Tennessee uses 5085kHz and broadcasts have been noted at 0600UTC, while lately they move to 9400kHz. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Standard Time and 13 hours behind New Zealand Standard Time.

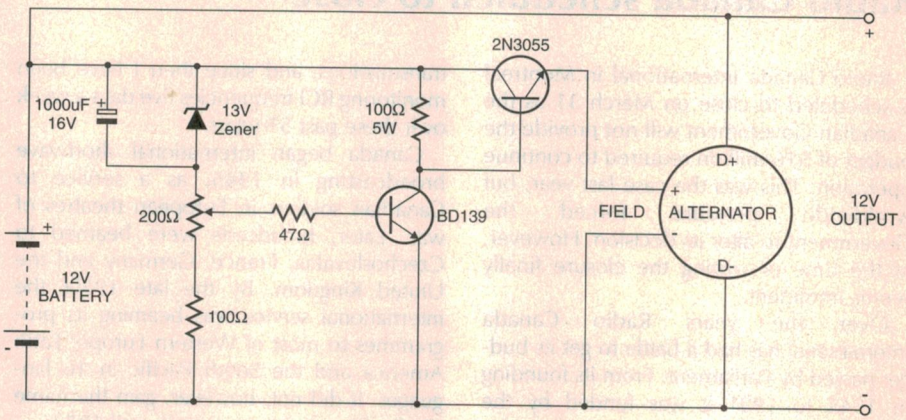
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Electro-mechanical battery charger

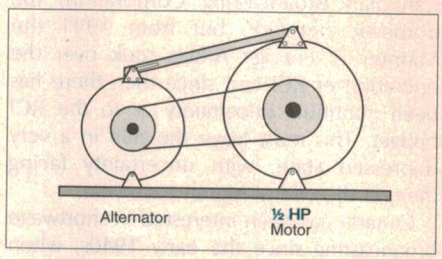
One problem with charging 12V lead-acid car batteries is finding a suitable high current transformer to do the job. To charge a 12V car battery quickly, charge currents of up to 30A can be used, but finding a transformer of this calibre is often difficult and expensive. The slightly unconventional system described here can supply up to 30A for battery charging, and can also be used as a high current 12V power supply.

A 1/2 horsepower 240V electric motor drives a standard car alternator using a belt and pulley arrangement as shown. To get the best results, the alternator needs to run at about 2000 RPM — so if the motor runs at 1000 RPM the pulley on the alternator needs to be twice the diameter of the one on the motor. (Similarly if the motor were 1500 RPM, a pulley 1.5 times that on the alternator would be required.)

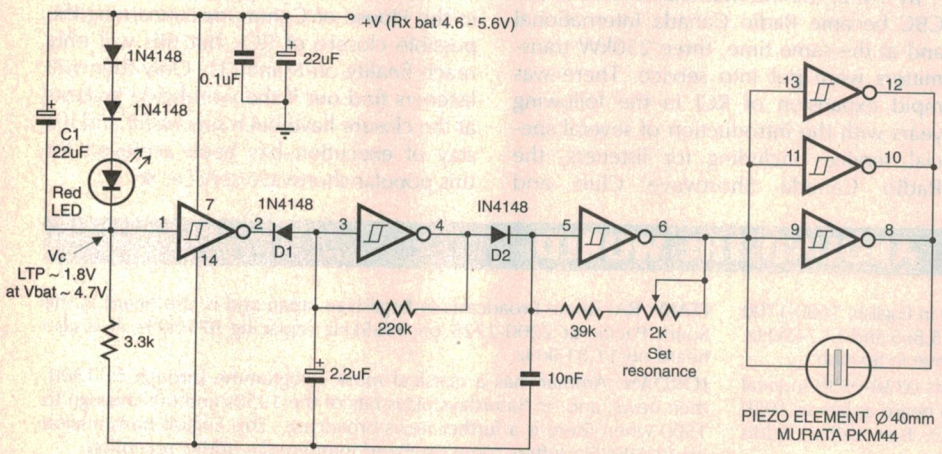


The circuit shows a simple voltage regulator, with the 200Ω pot allowing you to set the output voltage from 13.5 to 19 volts or more. This results in a wide current control when recharging lead-acid batteries.

David Francis
Cannon Vale Qld. **$30**



Low voltage alarm for R-C receiver batteries



Since the current consumption in remote controlled models can vary considerably with both the type of servos used and the frequency of commands, one can never be sure how long the receiver's battery will last on one charge. It is fairly obvious though, that a flat battery can cause a nasty accident and crash the plane! That is why I installed this circuit in my models, giving me peace of mind.

The circuit consists of a level detector (left), two relaxation oscillators (centre) and three parallel drivers (right). The IC is a high speed CMOS Hex Schmitt trigger with upper and lower trigger points at approximately 2/3 and 1/3 Vdd. The Motorola brand ICs that I used had a LTP of 1.8V at a Vdd of 4.7V.

Initially the level detector output (pin 2) is low. When the circuit is switched on, C1 holds pin 1 momentarily high, but charges quickly to a level governed by the voltage drop across the two series diodes and red LED. When the battery is fresh the voltage stays above the LTP of the Schmitt trigger, but when battery falls below 4.7V, Vc at pin 1 goes below 1.8V and the detector output toggles high. This enables the beep oscillator (D1 is now reverse biased), switching the tone oscillator on and off at 3Hz.

Whenever D2 is reverse biased a 3kHz square wave appears at pin 6, switching the three output gates high and low. Since the piezo reacts capacitively, its polarity is constantly reversed and the voltage across it effectively doubles. When tuned to its natural resonant frequency, it emits an ear-piercing sound easily heard above the noise of the model's engine. Depending on the piezo element used, the resonant frequency can range from 2kHz to 5kHz and the timing resistors (39k + 2k trimmer) of the tone oscillator must be adjusted accordingly. This circuit has saved me one model already (hundreds of dollars worth), after one of the servos drew excessive current.

Manfred Schmidt,
Edgewater, WA **$35**

Turn indicator/blinker

This device is a cost-comparable turn indicator for your car or truck. It runs at a constant rate, and you can attach a caravan or trailer and be confident that your indicator rate will remain within the legal parameters (high to start, switch at a frequency between 1 and 2Hz, and audible to the driver).

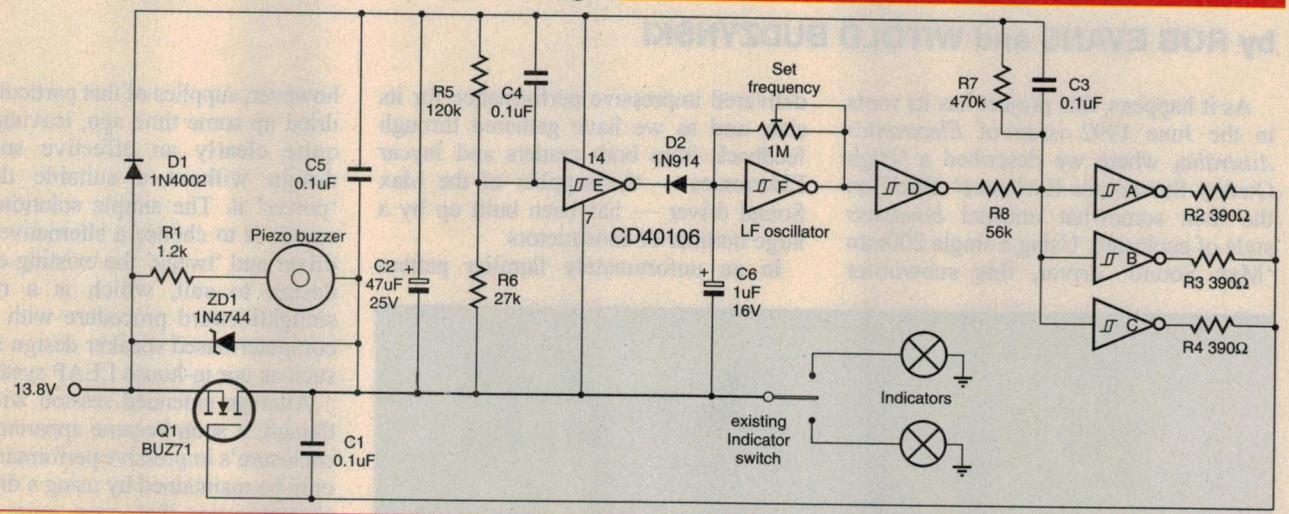
The operation depends on the indicator switch being of the centre-off type. When it is operated, C2 will charge up quite quickly. Meanwhile, C4 puts a momentary high to inverter E, which puts a low on the input of inverter F, disabling the oscillator, but allowing a high output from gates A, B and C after C3 has charged up by the low output of inverter D. We provide this small time delay so that we can be certain that C2 is fully charged up.

The MOSFET Q1 is then biased on, by the application of 13.1 volts to its gate, relative to its source terminal — causing the indicator globes to have full potential applied. The energy remaining in C2 keeps the oscillator going, so that at the first negative swing of the gate, Q1 turns off and C2 is then recharged, ready for the next cycle. Don't forget that the negative line of our control circuit is actually 13.8 volts above the car's battery negative. C2 is only supplying energy to our circuit.

Layout isn't critical and the circuit can be assembled on Vero board, but use MKT type capacitors and when you are happy it is working OK, use cyanoacrylate to glue them to the phenolic as a precaution against vibration. Pad the value for R1 so that it gives enough piezo volume, given the usual ambient road noises. Install it all in a jiffy box, using an aluminium heat sink for Q1 and leave the lid off. Lash it to the underside of the dash. Cost?? About $16 of retail parts, and a little bit of fiddling.

Peter Lucock,
Wynnum West, Qld. **$30**

THIS MONTH'S PRIZEWINNER!



Heater switching system gives 3dB steps

While I originally designed this switching system to replace the old control on my double electric blanket, there is no reason why it couldn't be used in any other type of heating (or lighting) application. A four-pole five position rotary switch (with an adequate contact rating) was pressed into service to switch the four heating elements into five different series/parallel combinations, with the added benefit that an equal amount of power is dissipated from each pair of elements.

With the switching system shown, the following combinations are used:

1: Elements A, B, C and D all wired in series;

2: A and D in series;

3: A + B and C + D in series/parallel;

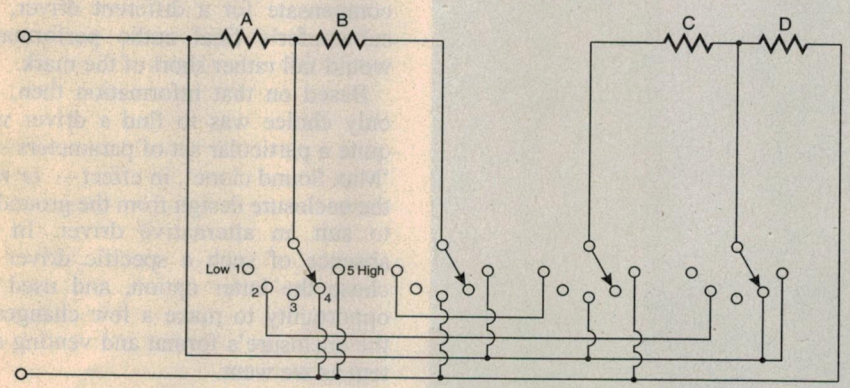
4: A and D in parallel;

5: A, B, C and D all wired in parallel.

This gives five different heat settings, in even 3dB steps.

Note that it doesn't matter if the switch wipers short between contacts when the switch is operated, as no two adjacent contacts connect to different parts of the circuit.

Graham Leadbeater
Ringwood, Vic. **$30** ❖



WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a compact CCD video camera module from sponsor **Allthings Sales & Services,** offering 460 TV lines of horizontal resolution and 0.05 lux sensitivity, and valued at $199.00!

Construction project:

HIGH PERFORMANCE COMPACT SUBWOOFER

This low-cost subwoofer enclosure can be used to extend the bass response of just about any small or medium sized speaker system, and delivers a clean, unfussed output down to around 30Hz. It uses an inexpensive 200mm driver from Jaycar, has a nominal power rating of 120W, and the cabinet can be constructed in either a low-profile or 'tower' format.

by ROB EVANS and WITOLD BUDZYNSKI

As it happens, this project has its roots in the June 1992 issue of *Electronics Australia*, where we described a 'High Quality Subwoofer Enclosure' based on the then somewhat unusual *bandpass* style of enclosure. Using a single 200mm 'Max Sound' driver, this subwoofer delivered impressive performance for its size, and as we have gathered through feedback from both readers and Jaycar Electronics — the supplier of the Max Sound driver — has been built up by a large number of constructors.

In an unfortunately familiar pattern however, supplies of that particular driver dried up some time ago, leaving what is quite clearly an effective subwoofer design without a suitable driver to 'power' it. The simple solution here of course is to choose a alternative 200mm driver and 'tweak' the existing enclosure design to suit, which is a relatively straightforward procedure with the help computer-based speaker design software, such as our in-house LEAP system.

After an extended session with LEAP though, it soon became apparent that the enclosure's impressive performance could only be maintained by using a driver with characteristics that were quite close to those of the original Max Sound unit.

The problem here is that the performance of a bandpass enclosure depends on a complex set of interactions between the driver, enclosure shape/volume and port tuning, and a significant shift in driver parameters can have quite dramatic results. LEAP clearly indicated that if we needed to use more than a modest degree of tuning correction to compensate for a different driver, the subwoofer's final audio performance would fall rather short of the mark.

Based on that information then, our only choice was to find a driver with quite a particular set of parameters — a 'Max Sound clone', in effect — *or* redo the enclosure design from the ground up to suit an alternative driver. In the absence of such a specific driver we chose the latter option, and used the opportunity to make a few changes in the enclosure's format and venting system as we went.

Our prototype enclosure, fitted with two 'planar' feet rather than four separate feet. This is OK if the enclosure is to be placed in the open, but is not recomended for placement in a corner.

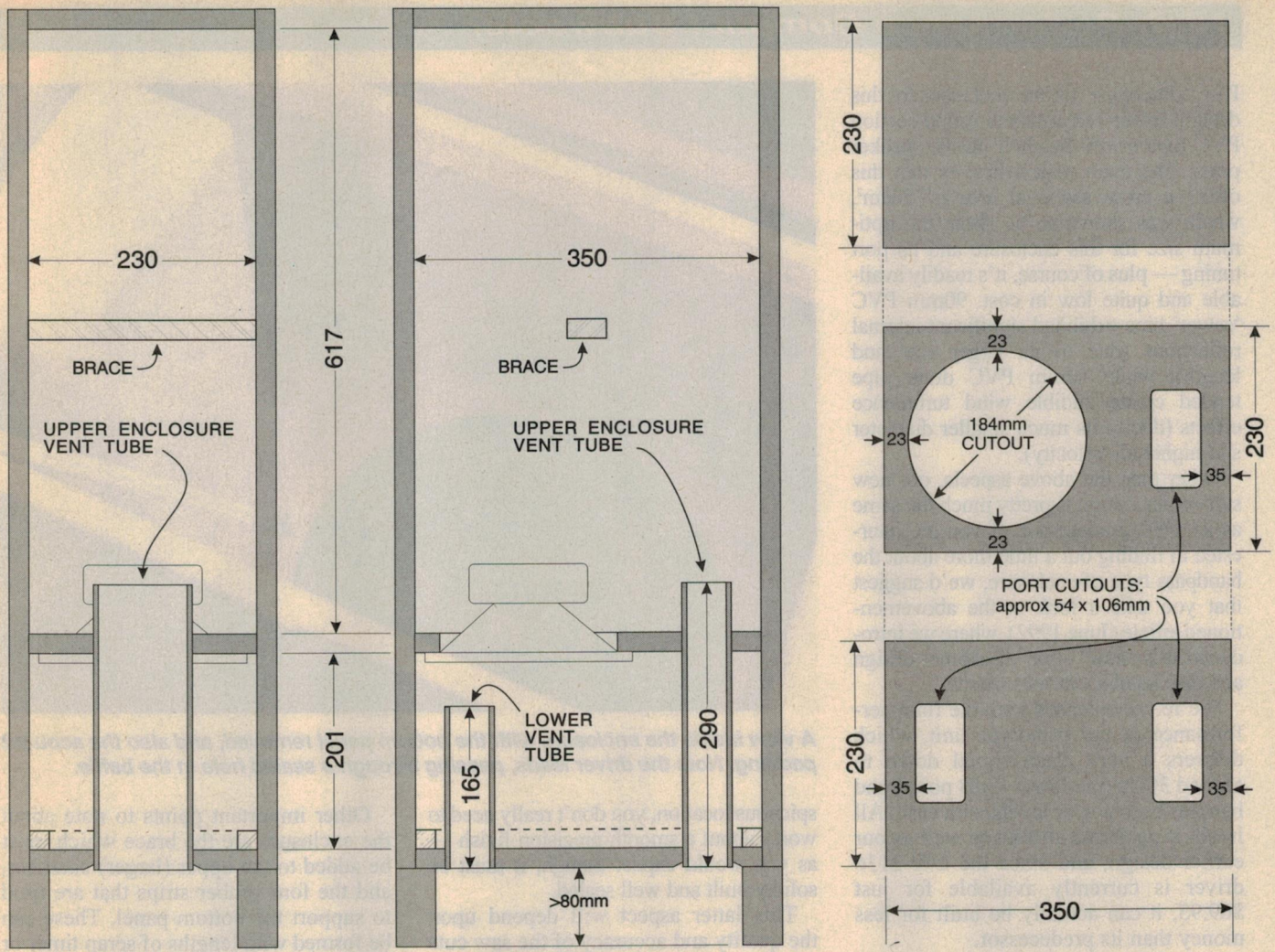


Fig.1: The enclosure should be easy to build and assemble using this diagram as a guide. Note that many of the dimensions are internal — remember to allow for MDF board thickness before cutting. The vent tubes are cut from 50x100mm PVC 'downpipe'.

The new design

Jaycar Electronics duly sent us a number of samples from their 200mm range of drivers for evaluation, which were then tested using both our IMP and LMS speaker testing systems. LMS comes from the same stable as LEAP by the way, and like IMP is able to derive a speaker's electro-mechanical parameters from two impedance plots — one measured in free-air and the other taken while the driver is in a known cabinet volume.

After some testing we found that Jaycar's high-powered 'Polycone' model (catalog number CW-2136) would suit our needs quite well, and exhibited a free-air resonance (Fo) of around 41Hz, a total Q factor (Qts) of 0.45 and a equivalent compliance volume (Vas) of about 32 litres. These figures are quite compatible with a bandpass enclosure design, even though the Vas rating is quite different from that of the Max Sound driver used in the original design, which was tested at 45 litres.

The CW-2136 is quite a rugged little driver, featuring a substantial magnet assembly and very compliant rubber surround. The initial calculations with LEAP suggested that it would deliver a smooth response down to around 40Hz in a 50-litre bandpass enclosure. Further work with LEAP indicated that the results would be even better in a suitably tuned 65-litre cabinet, so considering that this translated to a relatively modest increase in cabinet dimensions, we elected to base the new design on this volume. The earlier unit using the Max Sound driver featured a 52-litre enclosure, by the way.

You may have noticed from the diagrams and photos that our final cabinet arrangement is fairly tall and narrow, and we've taken the unusual approach of facing the vent tubes towards the *bottom* of the enclosure. With this scheme the vent outlets are coupled to air in the space created by the cabinet's four supporting legs, and this in turn radiates sound into the listening area.

In short, this setup really does work well, and while it may seem that the ports are 'firing' directly into the floor, extended testing has showed that the results match that of a conventional arrangement for frequencies below about 200Hz. This is presumably due to the very long wavelengths involved, so the ports could perhaps be thought of as applying air pressure rather than radiating sound as such.

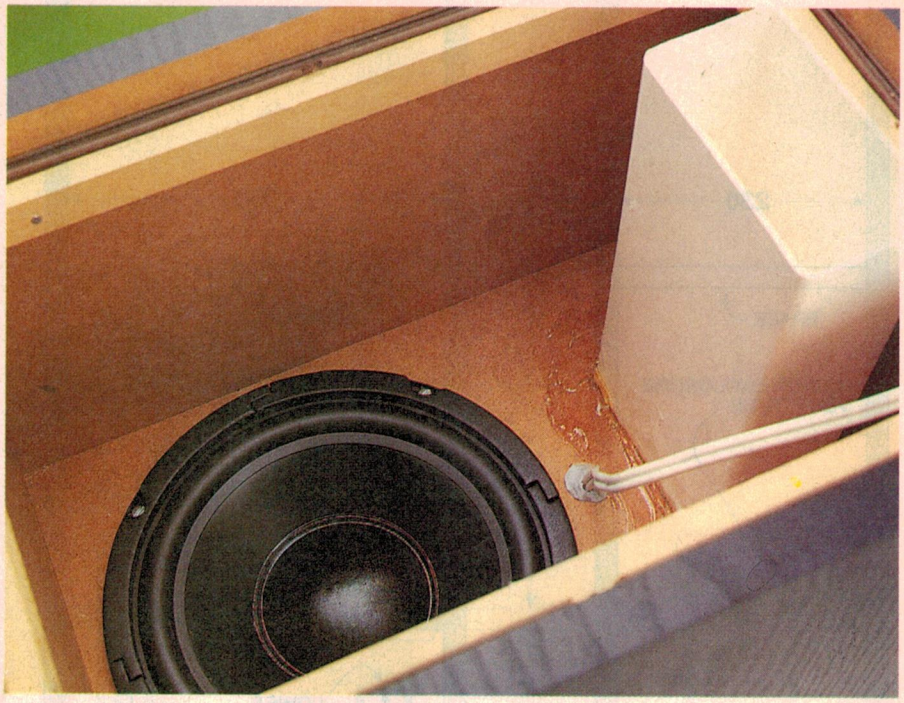
The main advantage of this enclosure layout is that it has very clean lines — no visible port holes, you could say — and does not radiate sound from any one side panel. This in turn means that the subwoofer looks very unobtrusive, and can be placed within the room without too much concern for blocking or restricting its output. Plus of course, you can lay it on its side in a more conventional manner if a relatively long but low-profile format is more suited to your needs.

We also elected to take the slightly unusual approach of using 50 x 100mm

PVC 'downpipe' for the vent tubes for this design, rather conventional round-section PVC tube or off-the-shelf plastic speaker ports. The main reason here is that this offers a cross sectional area of 50cm^2, which was shown to be about the optimum size for this enclosure and its port tuning — plus of course, it's readily available and quite low in cost. 90mm PVC 'sewer' pipe exhibited significant internal reflections (due to its larger size and length), while 50mm PVC drain pipe tended create audible wind turbulence effects (due to its much smaller diameter and higher air velocity).

Other than the above aspects, our new subwoofer design is pretty much the same as its 1992 predecessor. If you are interested in finding out a little more about the bandpass type of enclosure, we'd suggest that you take a look at the abovementioned article (June 1992), where we introduced this 'new' style of cabinet design and discussed its various merits.

We're very pleased with the final performance of our prototype unit, which delivers a very clean signal down to around 30Hz (the lower -3dB point) and handles high power levels with ease. All in all, it performs at least as well as our earlier design, and since the CW-2136 driver is currently available for just $69.95, it can actually be built for less money than its predecessor.



A view inside the enclosure with the bottom panel removed, and also the acoustic padding. Note the driver leads, passing through a sealed hole in the baffle.

Construction

As you can see from the cabinet assembly diagram (Fig.1), the enclosure is reasonably easy to put together in spite of the rather unusual design. Our prototype box was made from 19mm MDF board using simple 'butt' joins between panels, with all mating surfaces both glued and screwed in place. Other than that, since the final enclosure will probably be painted in a dark colour and installed in an inconspicuous location, you don't really need to worry about a smooth precision finish — as you would expect though, it must be solidly built and well sealed.

This latter aspect will depend upon the quality and accuracy of the saw cuts around each panel edge, which should be clean, straight and at 90 degrees to the main surface. In this respect we would strongly recommend that you arrange for the panels to be cut using professional equipment, such as the large bench saws used in timber supply houses or joiner's shops. This can usually be done as you purchase the timber, and provided you have prepared some kind of cutting plan in advance, will be well worth the modest cutting fee.

Other important points to note about the enclosure are the brace which must be added to the upper (larger) chamber, and the four timber strips that are used to support the bottom panel. These can be formed with lengths of scrap timer or appropriately-sized MDF board offcuts.

The four lower strips allow the bottom panel to be removed for access to the driver and cabinet internals, so some form of sealing gasket must applied around the strip-to-panel mating surface, and the panel ultimately screwed in place. With this arrangement, the shorter (lower enclosure) vent tube stays attached to the bottom panel when it's removed, while the longer port remains fixed to the speaker baffle panel. While it's a slightly fiddly setup, this means that the seal between the long port and bottom panel must be broken to gain access to the cabinet's internals.

This arrangement works quite well if the long-port cutout in the bottom panel is chamfered around the outside edge, as indicated in the assembly diagram. The slightly enlarged opening provides a convenient gap for a bead of silicon sealant, which is then easy to cut away when the bottom panel must be removed.

The other two openings where the pipe must be permanently fixed should be coated with a generous layer of silicon sealant before the tubes are installed

Another interior view, showing where the acoustic padding is placed in the lower chamber. When the bottom panel is added, its vent tube pushes the padding at left to the far end.

and aligned as shown. They should then be held in a stable position for an extended period while the sealant cures, and if necessary, braced internally across the narrow dimension during this process — the 100mm sides may flex in towards the centre of the opening if the pipe is a firm fit.

If you decide that the rectangular format pipe is too much trouble by the way, 80mm round PVC pipe could be used instead. It's rather more difficult to find, but offers very close to the same area as the 100 x 50mm pipe, so the port lengths can remain as specified.

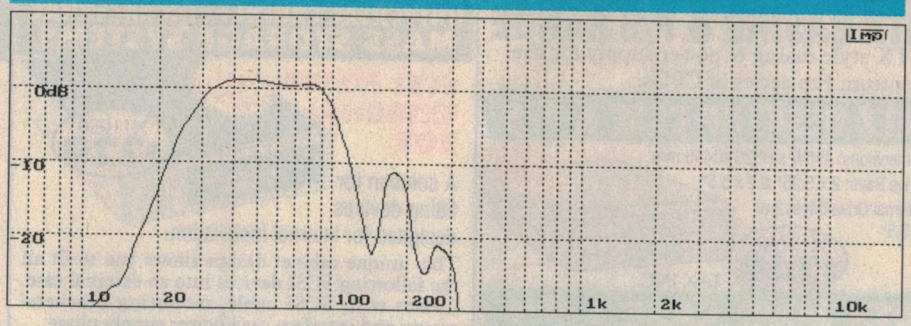
Other than that, the enclosure should be assembled in the normal way, with a fold of damping material such as Innerbond tacked inside each chamber, and a stout section of speaker cable fitted between the driver and the speaker terminal plate. We chose to mount the plate into the bottom panel so as to maintain the cabinet's clean lines, however some constructors may prefer to use one of the side panels as the connecting point, in a more normal way. With our approach the cable must pass through a hole in the speaker baffle, which must be closed off with sealant to preserve the air seal between the two chambers.

The driver and bottom panel are fitted during the final assembly stages, and should both have rubber gasket material applied to their mating surfaces. Common draft-sealing strip (the water proof type) works well here, and should be applied in a continuous fashion so as to avoid small air leaks in the gasket seal. Also, make certain that the internal speaker lead or acoustic wadding cannot come into direct contact with the speaker cone, as this will create audible overtones and could eventually damage the driver itself.

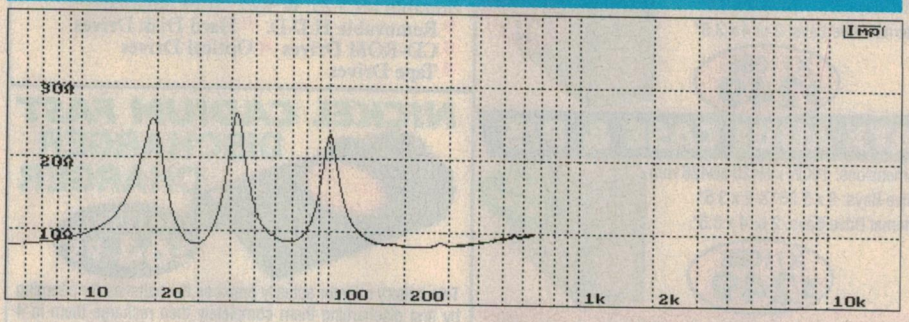
A final point to mention is the construction and positioning of the enclosure's four supporting legs, which as shown in the assembly diagram should raise the box at least 80mm above the floor. Besides this minimum height stipulation, the leg design and shape is not overly critical and could be cut from a scrap of (say) 50 x 50mm timber, or even shaped from the actual box side panels. If you're using square-section timber though, note that the legs should be attached to the bottom panel only, so that it can still be removed.

With the assembly completed, the cabinet can be sanded then painted in a suitably unobtrusive colour. We rounded the four vertical edges of our prototype enclosure for a more professional finish, and not surprisingly, painted the complete unit in traditional 'subwoofer black'.

Frequency response



Electrical impedance



Performance

As with our previous subwoofer designs this new unit is must be driven by a dedicated amplifier, which is in turn fed by a suitable low-pass active filter. The 'Versatile Subwoofer Adaptor' from the May 1989 issue of *EA* is designed for this exact purpose and can be coupled to (say) a spare stereo amplifier. Alternatively the 'Active Crossover for Subwoofers' presented the September 1989 issue can used in a similar fashion.

If you have the money to spare however, we can highly recommend the '300W Subwoofer Amplifier' from the May and April 1995 issues of *EA*, as this incorporates a full two-way active subwoofer crossover coupled to a high-performance 300W MOSFET amplifier. The combination of this amp system and our new subwoofer is extremely effective, and when pushed hard, really did demonstrate just how much *clean* bass energy can be produced by a bandpass enclosure.

When it comes to setting up the subwoofer in your own listening room, you should find that its positioning is not overly critical. While it's best to avoid a corner location, we noted that surrounding walls and furniture did not have a detrimental effect on the response — it seems quite happy with two of the four 'outlet' sides obstructed by nearby objects.

After a period of testing however, we did find that the subwoofer delivers the cleanest signals in its upright position with the ports facing the floor. It seems that the few remaining upper harmonics in its output — such as the port reflections shown in the response plot — are nicely attenuated by the extended path (via the floor covering) to the listening area. As such then, we'd have to say that the upright (on legs) format is the preferred arrangement this design, rather than the low-profile format where the box is on its side and the ports fire directly into the listening area.

The frequency response graph presented here was measured with the subwoofer in a typical setup, and shows the upper and lower -3dB points as 30Hz and 95Hz, respectively. As you can see from the plot the response between these points is quite smooth, while the upper end shows a series of lower-level peaks that are typical of bandpass designs. The associated electrical impedance plot is in the classic three-hump bandpass shape, and shows a minimum impedance of around 8Ω with two dips at the enclosure tuning points of about 29Hz and 67Hz.

So that's about it for our new subwoofer design. We'd like to acknowledge the important contribution of *Electronics Australia's* own production editor Witold ('Vitek') Budzynski to this project. Vitek is an experienced and enthusiastic loudspeaker designer, and was responsible for both the enclosure construction and a host of valuable design suggestions during the course of the subwoofer's development. ❖

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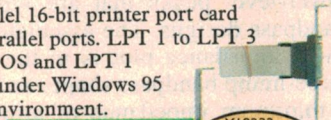

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SC AUG '96

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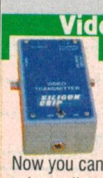
Video Transmitter and Receiver



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Construction Project:

PC-DRIVEN ARBITRARY & FUNCTION GENERATOR - 3

In this third article describing our new PC-driven function/arbitrary waveform generator, we look at its construction, setting up and functional testing. Also introduced is a software program to get you going: a simple function generator which allows you to produce signals from 0.25Hz to over 100kHz, in any of six handy waveforms.

by JIM ROWE

Now that those pesky 'bugs' in the design have been sorted out, as described in the second of these articles, it's at last time to describe the generator's construction.

As you can see from the internal photos, the construction is quite straightforward as just about all of the circuitry is mounted on two PC boards. The smaller of the two, measuring 114 x 51mm (code 97afg3a), mounts vertically behind the front panel and carries the analog output filter, buffer and attenuator circuitry — along with the indicator LEDs. This board is mounted directly on the back of the attenuator switch SW1, and supported by it.

The larger board measures 137 x 117mm (code 97afg3b) and mounts horizontally in the bottom of the case. It carries all of the digital and power supply circuitry.

There are relatively few off-board connections. The ribbon cable connecting the generator to the PC printer port is terminated in a 26-way IDC connector, which mates directly with a 13x2 pin header strip on the rear of the horizontal PCB. Similarly the three wires from the secondary of the power transformer, mounted alongside the main PCB on a metal plate, connect directly to the PCB at the other rear corner.

The 'raw' analog output from the main board is carried to the vertical front board via a short length of light duty co-ax, and the only other connections between the two are four short wires at the front to drive the LEDs, and three to provide the analog filter/buffer IC (U17) with power. The only other off-board connection is another length of light co-ax taking the trigger signal to an insulated BNC socket mounted separately on the front panel.

With the exception of the pin header strip, all connections are made to PCB terminal pins mounted on the PCBs.

Everything fits inside a standard four-piece plastic instrument case measuring 200 x 160 x 65mm — although to minimise output radiation, it's a good idea to substitute a piece of unetched copper laminate (copper side inwards) for the original plastic front panel. The copper layer can then be earthed via the analog output connector, to provide a measure of shielding.

As usual with this type of project, it's a good idea to assemble the components on each of the boards before you fit them into the case. I suggest you start with the smaller board first, as it has fewer parts on it. The overlay diagram of Fig.1 shows where everything goes, and how they're orientated.

You'll need nine PCB terminal pins for this board — two for the analog signal from the main board (near C1), three for the +/-12V power for U17 (above SW1), and four for the connections to the display LEDs (at lower left, above R11). Note, however, that in contrast with the main PCB the pins on this board are fitted to the *copper* side — so they're facing the main board when both are installed in the case.

The connections to the main analog output (lower right) are made directly to the BNC connector via short lengths of tinned copper wire, when the board is finally mounted on the front panel.

After fitting the PCB pins, I suggest you fit the rotary switch SW1 next, because it's often necessary to fiddle a bit before the switch pins mate correctly with the PCB holes — and this is easier if the board isn't already populated with minor parts. It's also easier later if you cut and trim the switch shaft to the correct length (about 10mm) before fitting it to the board. Don't forget to set the switch's detent ring for only four active positions, either!

With the switch fitted and soldered into place, you can then add the low-profile resistors and capacitors — taking care to fit the TAG tantalum electro C4 the correct way around. You can also fit filter/decoupling choke L2, which consists of eight turns of 0.25mm enamelled copper wire, wound on a single-

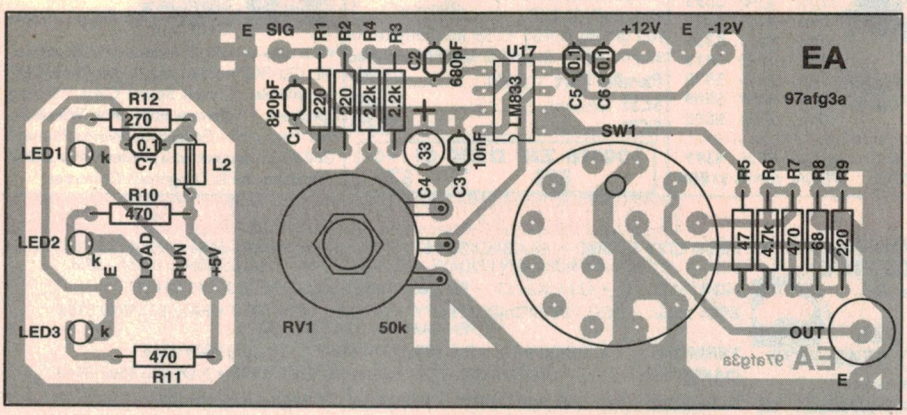
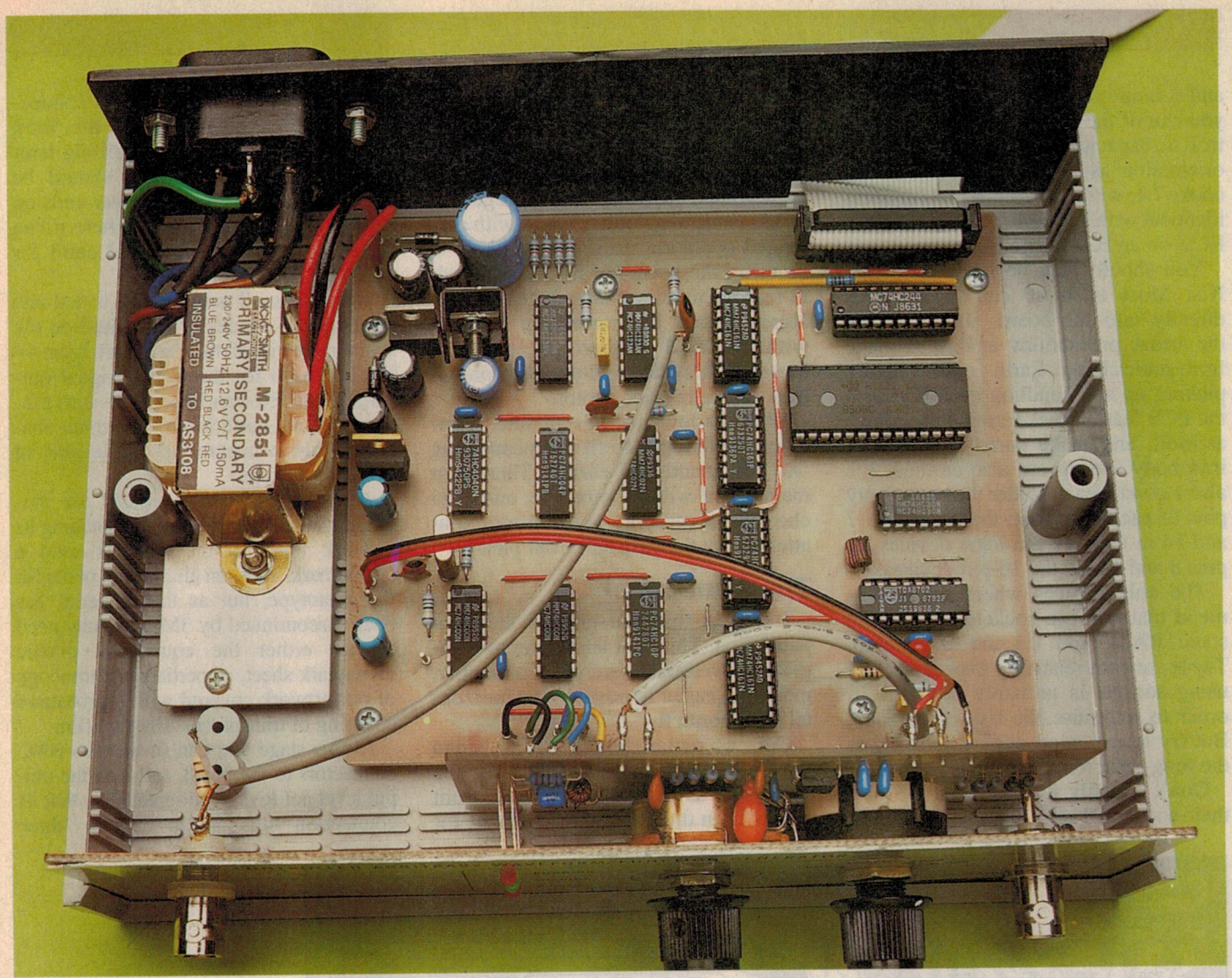


Fig.1: The wiring/overlay diagram for the generator's vertical board, which mounts directly behind the front panel and carries the analog filter and output circuitry — as well as the indicator LEDs.



This inside shot of the generator should clarify most aspects of its construction. The ribbon cable from the computer's printer port enters at upper right, connecting via a 26-way IDC socket.

hole 'bead' of F29 ferrite material. (L1 on the main board is identical, so you might want to wind it at the same time.)

Note that output level pot RV1 isn't mounted on the PCB, but is fitted to the front panel and connected to the board later.

To complete the vertical board assembly at this stage you only have to add the LM833 op-amp chip U17. (The three LEDs are best left until later, when the board is mated with the front panel.) A socket is not needed for U17, and it's best soldered directly into the board.

This completes the basic assembly of the small board, and after checking it for inadvertent wiring errors (like components fitted with reversed polarity) you may like to put it aside while you assemble the main board.

The main board

Fig.2 shows the corresponding overlay diagram. As you can see there are rather more components to fit on this board — although most of them are ICs and bypass capacitors. There's also a reasonable number of above-board links (the price we pay for a cheaper single-sided PCB), and some 14 PCB terminal pins.

I suggest you again start with the PCB terminal pins, and perhaps also the 13x2 pin header strip (J2). Note that there are three terminal pins at rear left (near D1 and D2), three more near the front on the same side (between C29 and C30), four at the left front (near U15) and two at front right (near R13 and C8). The final two are for the trigger signal output, at rear centre of the board (between U12 and U7). All of these pins mount on the board in the convenventional way — from the top.

The pin header strip mounts at right rear of the board, just to the rear of U1 and R25.

With the pins and header strip fitted, it's a good idea to fit the various above-board links next. There are 23 of these, many of them quite short and easy to fit using short lengths of tinned copper wire or component lead offcuts. For the longer ones I suggest that you use insulated copper wire, however, to minimise the risk of accidental shorts.

Note that there's one link (the longest) which 'meanders' over the board between components, rather than being straight and direct. This one is not shown on the overlay diagram in its entirety, for clarity; only its ends are shown, with arrows and 'X' symbols. One end connects to the board near C20 (at the end of U1), while the other connects between U10 and U13.

Actually I suggest you leave this link until after you've added some of the ICs to the board (especially U6, U7 and U10), because once fitted it will tend to make these harder to fit.

When all of the other links have been fitted, though, you can fit the low-profile components — resistors, monolithic

and ceramic capacitors, and so on. Then you can fit the rectifier diodes and electrolytic capacitors, taking care with their orientation as usual. You can also fit choke L1, which as mentioned earlier is identical with L2: eight turns of 0.25mm ECU on an F29 ferrite bead.

You should then be ready to fit the ICs. Most of these can be soldered directly into the board, simply taking the usual precautions against damage from static charge. Earth yourself before picking up and handling each IC, earth the PCB 'earth' track (around the edges) as well, and make sure the soldering iron body and tip are also earthed. It's also a good idea to solder the two supply pins of each chip first; these are pins 7 and 14 in most 14-pin logic devices, or pins 8 and 16 for the 16-pin devices.

The only devices where I'd recommend that you use sockets are U2, the static RAM, and U3 the DAC chip. These are both relatively expensive, and using sockets is probably desirable in order to minimise the risk of damage. But try to use good quality sockets, or the long-term reliability might suffer.

Don't actually plug U2 and U3 into their sockets at this stage — leave this until later. Do remember to fit the three voltage regulators, though — U18, U19 and U20. The two 12V regulators dissipate very little in this circuit, and need no heatsink. However the 5V regulator (U18) tends to get fairly warm with prolonged operation, so if you're likely to be using the generator for long periods in reasonably elevated ambient temperatures, it may be worthwhile fitting it with a small clip-on or screw-on heatsink. It's shown fitted with one of these in the interior photos.

With the low-cost ICs all fitted, now would be the time to fit the meandering 'X' link mentioned earlier. Then your main board will be complete, and after checking it carefully you can turn your attention to the case and front panel.

The front panel

I suggest that you prepare the front panel first. This will allow you to complete the vertical board/panel assembly, making it easier to position the horizontal PCB correctly.

Cut a rectangle of single-sided unetched PCB laminate, exactly the same size as the original plastic front panel. Then drill and ream the holes for the various controls, LEDs and connectors, using a photocopy of the front panel artwork (Fig.5) as a drilling template. Note that the holes should be located so that the copper layer ends up on the inside of the panel, where it can be easily connected to signal earth for effective shielding.

Another small point to note is that one of the BNC connectors mounted on the front panel is of the insulated type — the one used for the trigger signal output, on the left-hand end. This is to prevent internal earth loops. The main analog output connector is of the normal uninsulated type.

After the holes in the panel are prepared, you can complete it by attaching its artwork layer to the front. I used a 'Dynamark' stick-on aluminium panel for the prototype, but as this material has been discontinued by 3M, you may need to use either the equivalent plastic Dynamark sheet, or perhaps a photocopy of our artwork covered with a protective covering of transparent adhesive film.

At this stage you can fit the two BNC connectors to the panel, and also the output level pot RV1 — orientated so that its connection lugs are at exactly 'three

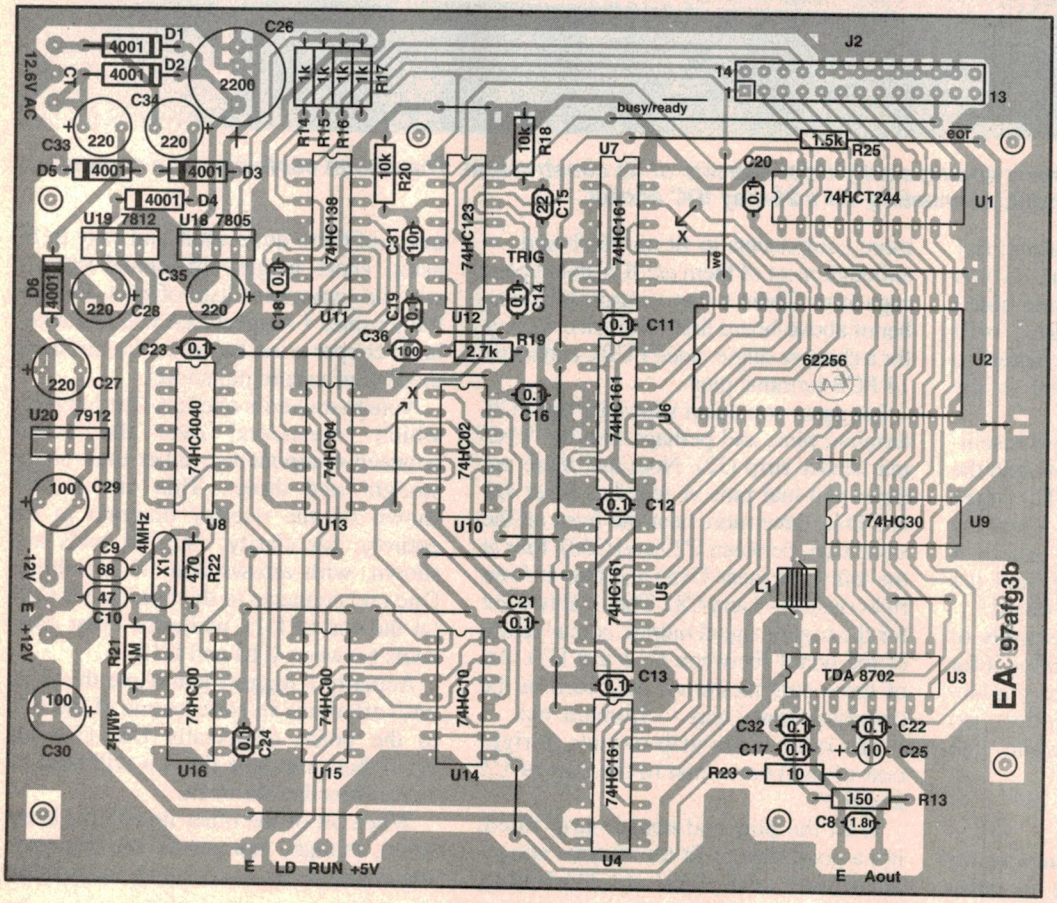


Fig.2: Use this wiring/overlay diagram for the main board as a guide when you're fitting all the components to your own board. Note that one of the above-board links is not shown complete, for clarity: only its ends are shown, each identified with an 'X'. One end is between U1 and U7, the other between U10 and U13. Only U2, the static RAM, and U3 the DAC, need to be fitted via IC sockets - the others can all be soldered into the PCB.

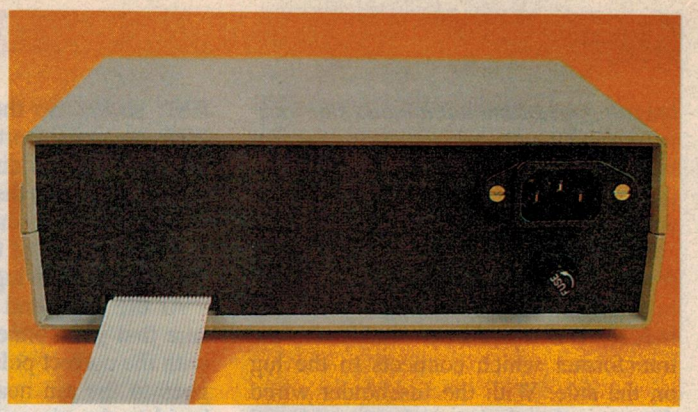
o'clock' as viewed from the front (i.e., facing directly towards the hole for SW1). Then you can prepare for mating the panel with the vertical PCB, by soldering three short lengths of tinned copper wire (say 30mm long) to the pot lugs, and also a pair of similar wires to the centre spigot and earth lug of the analog output connector. While fitting the last of these wires, you can also make the connection for earthing the front panel copper, by passing the end of the wire through the socket lug and soldering it to the copper before making the lug connection.

You should now be ready to offer the front panel and vertical PCB assemblies up to each other, for assembly. However before doing so, it's a good idea to fit the three indicator LEDs temporarily to the PCB, in their correction positions but with their leads left at full length until the correct length is found. The best plan is to fit them with their bodies about 8mm from the board, and with only one lead of each tack-soldered to its board pad.

I used 3mm red LEDs for LED1 (RUNNING) and LED2 (POWER), and a 3mm green LED for LED2 (LOADING). You can of course vary these colours if you wish, but the front panel artwork has been designed to take the 3mm size rather than the larger 5mm variety. Note that the cathode side of each LED (usually identified by a 'flat' on the side of the plastic body) faces towards RV1 and SW1.

By dressing the three leads from RV1, and also the two from the BNC socket, so they pass through the corresponding holes in the PCB, you should now be able to fit the two pieces together. You'll have to remove the mounting nut from SW1 to do this, and then re-fit it again to hold everything together. Make sure that the PCB ends up squarely aligned with the panel, of course.

Once this is done, you can solder the leads from the pot and BNC connector to their PCB pads. The tack-soldering of each LED can also be removed (e.g., with copper wicking), allowing each LED to be moved forward carefully so that its body just protrudes from the front of its matching hole in the front panel. Once it position its leads can then be properly soldered to the PCB pads, and any excess snipped off. A small fillet of adhesive can be applied around the body of each LED, behind the panel, to make them a little more secure.



A rear view of the generator, showing its simplicity — just the computer cable, mains input and mains fuse.

You should now be able to fit the control knobs to the pot and switch, to complete the basic front panel assembly.

If you fit the assembly into its correct slot in the lower half of the case, it can now be used as a guide to determine the correct final location for the main horizontal PCB. As you can see from the internal photos, the latter board mounts with its front edge about 8mm behind the vertical board, and with the right-hand edges of both (as viewed from the front) aligned almost exactly.

Needless to say, the precise location of the main PCB is where its six 3mm mounting holes line up with those in the appropriate mounting pillars moulded into the case bottom. These pillars should be noted and marked carefully, because you'll need to cut short some of the other pillars under the PCB — they tend to foul various component lead solder joints, and prevent the PCB from mounting flat and square. Which pillars need to be shortened varies according to the make of your case, and is best done by trial and error; just be careful not to remove the six needed for mounting the PCB!

Actually before you start clipping off pillars hither and yon, you may wish to make the small metal plate used to mount the generator's power transformer, and mount the two into the case as well. The plate is cut from a scrap of 1mm aluminium sheet, and its dimensions are shown in Fig.6. Note that all dimensions are in millimetres, and the holes are all 3mm in diameter. As you can see from the internal photos, the 'notch' is to clear the case assembly pillar at that end, allowing the transformer and plate to fit in neatly alongside the main PCB.

Before mounting the transformer onto the finished plate, and mounting the two into the case, I suggest you prepare the rear panel by cutting the mounting holes for the IEC captive mains plug and cartridge fuseholder — and also the slot at the other end, to clear the ribbon cable from the computer. The latter slot measures 35mm long by 8mm deep, and is located on the lower edge of the panel starting 21mm from the end.

I'll leave the exact size and shape of the plug and fuseholder holes to you, because they depend on the components you use. However they should be located on a vertical line 30mm from the left-hand end, as shown in the photos.

Fig.7 shows the way the transformer is actually mounted onto its plate, and also makes clear how the mains connections should be made to ensure maximum safety. Note that all of the active and neutral connection solder joints should be sleeved using pieces of heatshrink plastic tube, or close-fitting varnished cambric sleeving. The mains earth lead from the IEC plug connects to the solder lug on the rear transformer mounting bolt — which is fit-

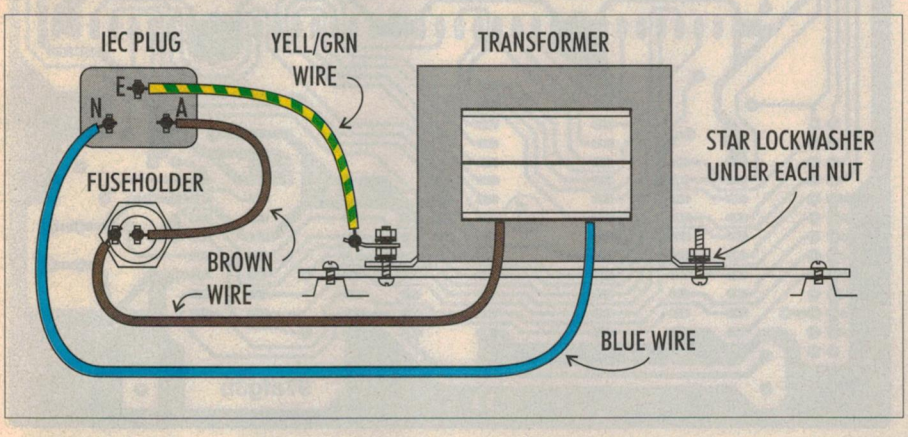


Fig.7: How the mains transformer is mounted on its plate, how the protective earth is connected, and details of the mains wiring. All mains connections should be covered using heatshrink or varnished cambric sleeving, for safety.

ted *using an additional nut and star lockwasher*. There's no direct connection between this 'protective mains earth' and the earthy side of the generator's low voltage circuitry.

Note too that the active (brown) wire from the 'A' lug on the IEC plug should be connected to the *end* lug on the fuseholder. It's the brown lead from the transformer which connects to the lug on the side. With the fuseholder wired this way, there's less risk of accidental shocks when the fuse is being fitted.

At this stage it's probably best to mount the main horizontal PCB into the case, after carefully removing those excess mounting pillars. The PCB is mounted using some of the small Phillips-head self-tapping screws supplied with the case.

With the power transformer already mounted in the case, you should now be ready for the final assembly stage: making the various off-board and inter-board connections.

I suggest that you swing the rear panel temporarily aside, and carefully connect the three transformer secondary leads to their respective terminal pins at the rear left corner of the main PCB. Don't leave the leads at their original length, because they'll get in the way later; instead cut them to about 70mm long — just enough to curve around to the pins, without strain. Bare about 5mm only at the ends, and tin each one carefully so it can be reliably soldered to the PCB pins with a minimum of heating. The centre-tap wire goes to the centre pin, by the way.

Now you can plug the ribbon cable's connector onto the 13 x 2 pin header on the back of the main board, and swing the rear panel back into position.

Now you can fit the connections between the two PCBs. I suggest that you fit the four short connections for the indicator LEDs first, then the co-ax cable carrying the DAC output signal from the main board to the vertical board, and finally the three wires taking +/-12V to the vertical board (from the pins between C29 and C30). Take special care with these last wires, to ensure that you don't reverse the supply connections — this could cause damage later on!

The last off-board connection to fit is the second and longer co-ax cable, carrying the trigger output signal to its front panel BNC socket. This is made slightly more complicated than otherwise because R24, the 100Ω protective series resistor, could not be fitted easily on the main PCB and is actually mounted on the rear of the BNC socket. So the resistor (with both leads cut quite short — about 6mm) has one end soldered directly to the socket's centre spigot, and the inner wire of the co-ax is connected to the resistor's other end. The shield braid of the co-ax connects to the socket's earth lug in the normal way.

At the PCB end of the co-ax, make sure that you connect it to the two pins with the correct polarity. The inner wire goes to the pin nearer to U12, and the braid to the pin nearer U7. (A reversal here could again cause damage later.)

Your generator should now be completely wired, and ready for initial testing — although before proceeding, check all of your off-board connections carefully in case you've made any errors. It would be much less expensive to find them at this stage, rather than after power has been applied...

Initial testing

There's no need to connect the generator to your PC for the initial testing. The testing should also be done with the SRAM (U2) and DAC (U3) chips still *not* fitted to the main board, just in case there should turn out to be a power supply problem. You'll need a DMM or other high-impedance multimeter, though, set for reading DC voltages in the range -12V — +12V.

To begin, connect the DMM's common lead to a convenient source of the generator's 'signal earth' (say the earthy side of the main analog output connector), and ready the other lead/probe to measure the main supply rails. You'll be able to check the +/-12V rails at the pins on the top of the vertical PCB (above SW1), while the +5V rail can be checked at the pin 16 clip of the empty DAC socket (U3).

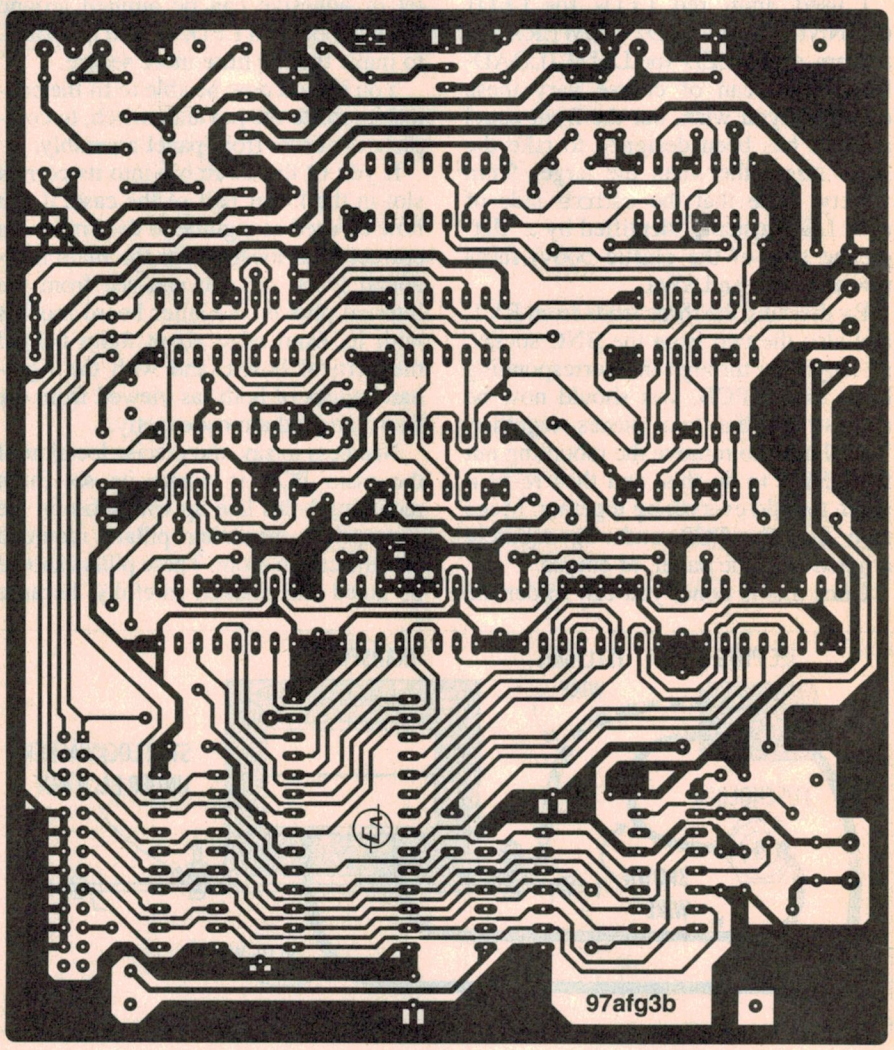


Fig.4: The copper etching pattern for the generator's main PCB, shown here actual size for those who make their own boards.

With these points identified, fit a 500mA fuse to the generator's fuseholder and apply the 240V power. The lowest LED (POWER) on the front panel should immediately glow, but even if it isn't try measuring the three supply rails without delay.

If one or more of the voltages isn't correct (i.e., within about 10mV of its correct value), switch off the power immediately and investigate. On the other hand if the voltages measure OK, but the POWER LED isn't glowing, the odds are that you've fitted the LED around the wrong way — so switch off and check this.

Otherwise, if the voltages seem correct and the LED is also glowing, your unit is probably functioning correctly at this stage. Just to make sure, though, try touching the heatsink lugs of each voltage regulator IC to see if they're getting hot. The 12V regulators (U19 and U20) should remain quite cold, but the 5V regulator (U18) will become noticeably warm (especially if you haven't fitted it with a heatsink).

If all seems well, turn off the power and carefully fit both the static RAM chip U2 and the DAC chip U3 into their sockets (taking care to discharge yourself before you handle them). Then connect the generator's ribbon cable to a printer port on your PC, turn on both the PC and the generator, and you're ready to try it out properly.

Functional test

The most direct way to give the generator a functional test is to run some software that 'knows how to talk to it'. And the simplest way to do this is to get a copy of the simple Visual BASIC program I've produced to get you going with the generator: FUNCGEN1. It's available via the EA Reader Information Service BBS.

The idea of FUNCGEN1 is to let you communicate with the generator, and get it to produce signals over a wide range of frequencies — from 0.25Hz to over 100kHz — and with a choice of any of six waveforms: sine, square, triangle, rectangular (with adjustable duty cycle), rising sawtooth and falling sawtooth. In other words, make it work as a fairly standard function generator.

We'll talk about this program in more detail in the next article, along with others that we hope to provide, to let you use the generator's 'arbitrary waveform' capability. But for the present, we'll discuss using it to give the generator a functional test.

First of all, start up the program and you'll see that it provides a screen representing the front panel of a 'virtual function generator'. Down at its lower left-hand corner, you'll see a button labelled 'Set I/O Port Addr'.

If your PC is fitted with a mouse, simply click on this button with the mouse cursor. Otherwise, press the <Alt> key and then the <P> key. Either way, a small dialog box will open up, designed to let you both select the address of the printer port to which the generator is attached, and then check that it's receiving commands and data.

In the dialog box you'll see that you

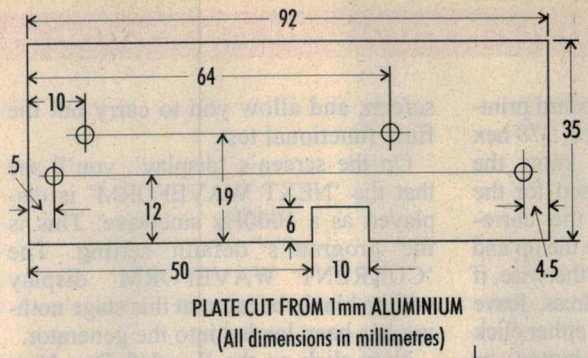


Fig.6 (left): the cutting and drilling information for the transformer mounting plate. All holes are 3mm in diameter. The notch is to clear the case assembly pillar.

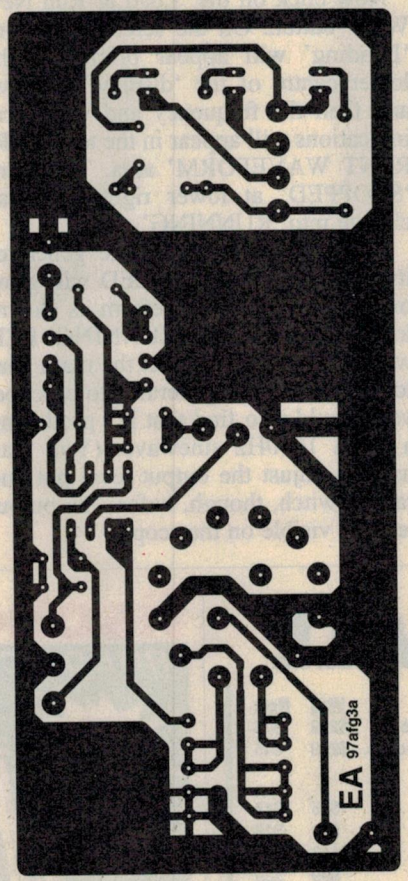


Fig.3: (above): The PCB pattern for the smaller board, again reproduced actual size.

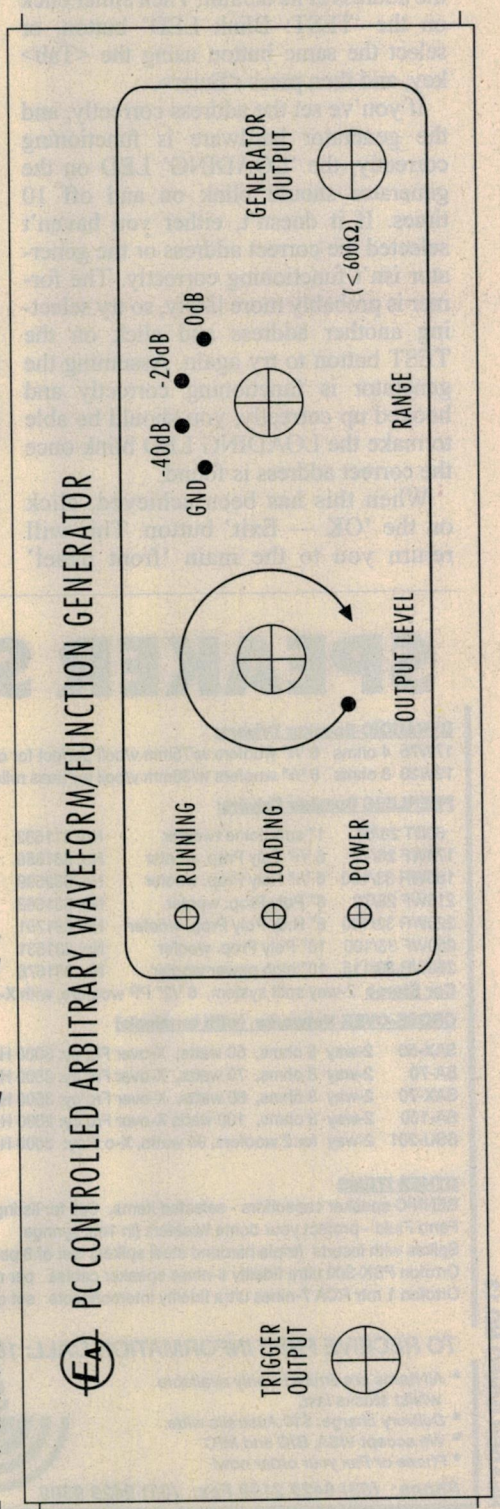


Fig.5: (right): The artwork for the generator's front panel, also reproduced full size.

can select any of the three standard printer port base addresses: 3BC hex, 378 hex or 278 hex. If you already know the address of the port you've used for the generator, simply click on the corresponding 'radio button', or use the up and down arrow keys to select it. Otherwise, if you don't know the port address, leave the address at its default. Then either click on the 'TEST: Blink LED' button, or select the same button using the <Tab> key, and then press <Enter>.

If you've set the address correctly, and the generator hardware is functioning correctly, the 'LOADING' LED on the generator should blink on and off 10 times. If it doesn't, either you haven't selected the correct address or the generator isn't functioning correctly. The former is probably more likely, so try selecting another address and click on the TEST button to try again. Assuming the generator is functioning correctly and hooked up correctly, you should be able to make the LOADING LED blink once the correct address is found.

When this has been achieved, click on the 'OK — Exit' button. This will return you to the main 'front panel' screen, and allow you to carry out the final functional test.

On the screen's 'display', you'll see that the 'NEXT WAVEFORM' is displayed as a 1000Hz sinewave. This is the program's default setting. The 'CURRENT WAVEFORM' display will be blank, because at this stage nothing has been loaded into the generator.

Now click on the 'Load & Run New Wfm' button. On the screen, the word 'Loading' will appear briefly at the lower centre of the 'display' window, and then the frequency and waveform indications will appear in the top 'CURRENT WAVEFORM' area. The word 'STOPPED' at lower right will also change into 'RUNNING'.

On the front panel of the generator itself, the 'LOADING' LED will glow briefly while the waveform is downloaded, and then the 'RUNNING' LED will glow. If you connect the main analog output of the generator to a scope, you should also find that it's producing a clean 1000Hz sinewave. (You may have to adjust the output level pot and range switch, though, before the output level is visible on the scope.)

You should be able to turn the sinewave on and off, and also the generator's 'RUNNING' LED, by clicking repeatedly on the 'Run/Stop' button on the screen. The indication at the lower right-hand corner of the screen's 'display' will also alternate between 'STOPPED' and 'RUNNING', mirroring the actions.

If these events all take place as expected, your PC-Controlled Arbitrary Waveform and Function Generator is now complete and confirmed as fully functional. So you can fit the top cover to the case, and start using it.

In the next article I'll explain a little more about using the FUNCGEN1 program, although you'll find that setting it for different output frequencies and waveforms is pretty intuitive. Graham Cattley and I also hope to present some programs that will let you exploit the generator's other capabilities — and a reader has already worked out an ingenious software technique to allow it to produce frequencies with a much higher incremental resolution (i.e., many more frequencies, especially at the high end of the range). So stay tuned!

(To be continued.) ❖

Experimenting with Electronics

by DARREN YATES, B.Sc.

Noise makers interlude — 1

This month, we digress from CMOS circuits just long enough to cover some old-fashioned 'noise-maker' circuits. From animals to machinery, electronics is very good at mimicking the sounds of the things we know and love around us.

First, my apologies to those of you who were waiting for the next instalment of CMOS circuits. I received a letter from a reader during this last month who was keen on circuits which produced 'noise'. Now I don't know whether this man already had kids in his life or not, but since part of my aim is to answer your questions as well as include circuits which I think are interesting, I thought it would make a good change. We'll get back to CMOS circuits in a couple of months.

The letter I received went a little like this:

Some time ago, I was wandering through a Tandy store and noticed this nice little gadget which made the soothing sounds of rain and waves rolling up on the shore. Would it be possible to cover a circuit to do this in a future issue of EWE?

Having dug through my notes and circuits file, I found a number of circuits that cover this genre. But unfortunately the circuit to answer the reader's query would have covered around five pages on its own. Instead, I thought it would be more practical to cover the basics of noise circuits, and give you the mechanics to build circuits that will mimic ocean waves and trains etc.

While we all can't get to the beach, there's no doubt that there is something soothing about listening to waves rolling up and crashing on the shoreline — whether it be after a hard day's work or just one of those 'summer days from hell'...

In practice, many sound effects circuits are bulky but reasonably simple. This stems from the fact that most sounds we hear are a combination of regular waveforms mixed with noise. As a result many of these sounds can be simulated using electronic circuitry by mixing regular waveforms with various amounts of noise. When you consider that's what most sounds are, it should be possible in theory. Steam trains, boats, horns, whistles — they can all (and have already) been accurately copied using electronics. And one of their major components is noise.

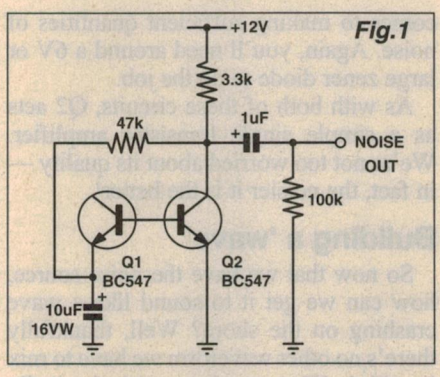


Fig.1

But how do you generate noise? Well, it's not that difficult. One bright spark once said that it's easy to make noise but harder to get rid of it. (I always think that around election-time...)

Noise circuits

Noise circuits can arguably be split into two areas — those that create random noise and those that produce a repetitive waveform. Of course, there are also those which produce both. Purists would say they *all* do the latter, but that's what purists are for.

Believe it or not, noise is very easy to generate. Just about every electronic component generates noise of one flavour or another. It has to do with electron flow, but without going into all the details, take it for granted that every component creates noise — some a lot more than others.

In fact, noise is such a big business that it even comes in various colours — white, pink and brown are just a few. The colours refer to the frequency spectrum of the noise and the amplification of frequencies.

Basic noise generator

This first circuit in Fig.1 simply generates good old fashioned plain-vanilla 'white noise'. This simply means that all frequencies occur at equal levels. As it turns out, you can't really get much simpler than this. Looking at the circuit, it may not be obvious at this stage but the circuit consists of a noise generator and an amplifier.

The trick lies in transistor Q1. While in normal operation it acts like a plain ordinary transistor, in this configuration, it produces quite a good amount of white noise — even though the collector of Q1 is not connected. It's the base-emitter junction which does all the work.

In normal operation, with current flow into the base and through the emitter, the B-E junction acts like a normal diode, namely with a 0.6V drop between the two points. But when you reverse the connections, the transistor exhibits a zener diode effect. It inhibits current flow up to a certain level of reverse voltage, but once the voltage kicks up above 5-6V or so, the junction avalanches and can allow copious amounts of current to flow until either it or the fuse blows up — in much the same way as an ordinary zener diode.

Before we go any further, there will be the purists who will already have complained of my use of what I was taught is 'conventional current flow'. Electrons do indeed flow in the opposite direction — that is, from the negative to the positive supply rails. However it is much simpler to understand circuit theory using conventional current flow. Anything that makes this subject easier to understand and allows people to get up and running with their own circuits, I'm all for and I make no apologies for it.

Back to the circuit, Q1 is reversed

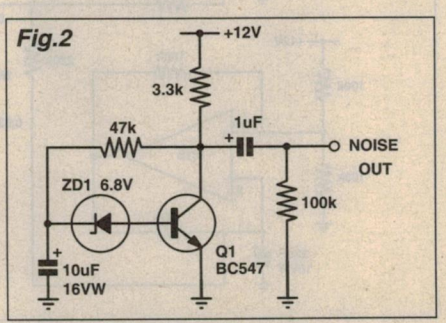


Fig.2

biased via the current flow through the 47k resistor and the path to ground through the B-E junction of Q2.

The capacitor at the emitter of Q1 stabilises that side of the junction so that our noise voltage appears at the other end — at the base of amplifier Q2, which is where we really want it. The amplified noise signal is then taken from the collector of Q2 and fed to whatever you like.

The only catch with this circuit is that you need a supply rail of at least 9V DC to get it to kick over. That's because of the zener-like action of the B-E junction of Q1. Usually the avalanche doesn't occur unless there's around 5-6V across it, so you need a little bit of 'headroom'.

With this circuit supplied at 9V DC, you should get about 3V peak-to-peak of noise, which is ample for most circuits.

Variation on a theme

Of course, since we are using the zener diode function of a transistor, you could replace it altogether with a zener diode. The circuit for this is shown in Fig.2.

Someone must be thinking that you could get away with using a 6V supply rail if you used a 3.3V zener diode. Correct? Wrong. Unfortunately, 3.3V zeners are just too darn 'quiet' when it comes to making sufficient quantities of noise. Again, you'll need around a 6V or large zener diode to do the job.

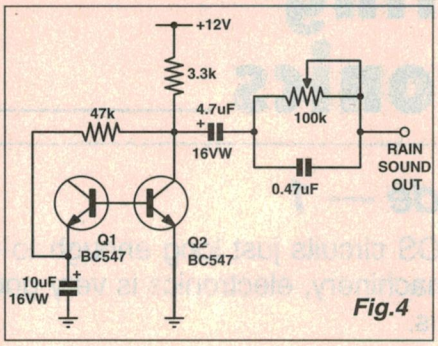


Fig.4

As with both of these circuits, Q2 acts as a simple single transistor amplifier. We're not too worried about its quality — in fact, the noisier it is the better!

Building a 'wave'

So now that we have the noise source, how can we get it to sound like a wave crashing on the shore? Well, thankfully there's no other waveform we have to mix in with it. Wave crashes consist basically of noise and not much else. All we have to do is *modulate* it with a regular waveform, and the most realistic modulation waveform that produces the right type of sound looks like a very average sawtooth.

If you listen to a waves at a beach, you'll hear a random collection of waves at various stages of their journey towards the shore. To copy that, we need more than one copy of the modulation waveform running.

We also need an electronically-controlled amplifier, to provide the ebb and flow in the waves. Rather than use some expensive, hard-to-get chip, I've used a rather novel solution. You can see the whole concoction in Fig.3.

Wave simulator

As I explained before, this isn't a fully complete circuit — in fact, you could quite easily expand it to create other effects such as birds, but we'll look at that another time.

Looking at Fig.3, we have three basic function areas: the noise generator consisting of transistor Q1 and Q2; the waveform generators using op-amps IC1a and IC1b; and the modulator, using IC1c. We've already looked at the noise generator and since it's exactly the same as before, we won't bother going through it again.

The waveform generators around IC1a and IC1b are basically Schmitt trigger oscillators running at a very low frequency. Even though they both use exactly the same component values, there will be enough difference in practice for us to get a nice rolling network of waves happening.

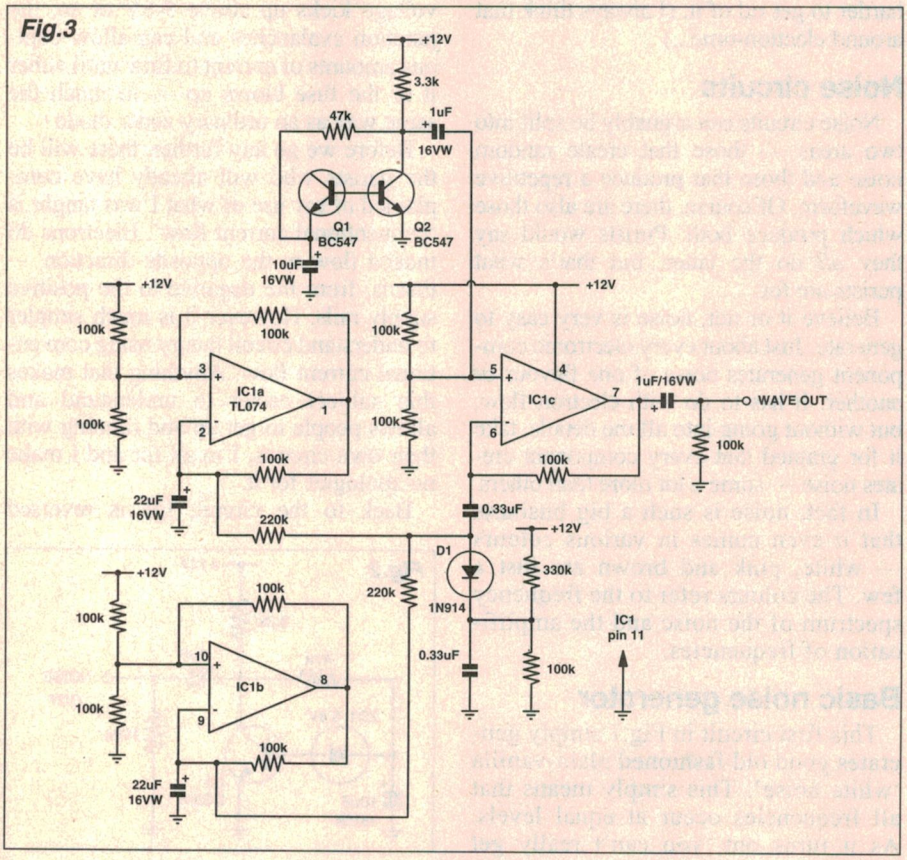
The interesting thing here is that we don't use the output from the op-amps, but instead the waveform across the capacitors. This 'rounded sawtooth' waveform is perfect for producing the right modulation we need...

In order for us to get the rolling wave sound effect, we need to mix these signals together and then drive the modulator, which itself is an unusual design. To make it even more realistic, I'd recommend you throw another waveform generator in, mixing in its waveform with the other two. I haven't included it here, for space reasons, but you should be at a stage now where you can see where it should go.

Using the principle we spoke of way back in the very first article when I took over this column, we've used an ordinary signal diode (D1) as a voltage-controlled resistor. By placing it in the negative feedback path of an ordinary op-amp amplifier, we can make a very crude but effective voltage-controlled amplifier.

What happens is that the waveform generators supply a voltage to the anode of the diode. If the waveform voltage is low compared to the cathode of the diode,

Fig.3



it's not biased enough to turn on so the amplifier sees a big resistance in this leg. The overall effect is little gain. However, when the waveform generator's signal voltage rises above the cathode voltage, the diode begins to conduct and its impedance falls. The op-amp now sees a reduced impedance in this leg, which causes the gain to increase. As I said, it's crude but works and works well.

The output signal can be taken from IC1c and fed to a small amplifier. Make sure you add a volume control. You'd be surprised how easy it is to fall asleep to this thing, when you listen to it for a while...

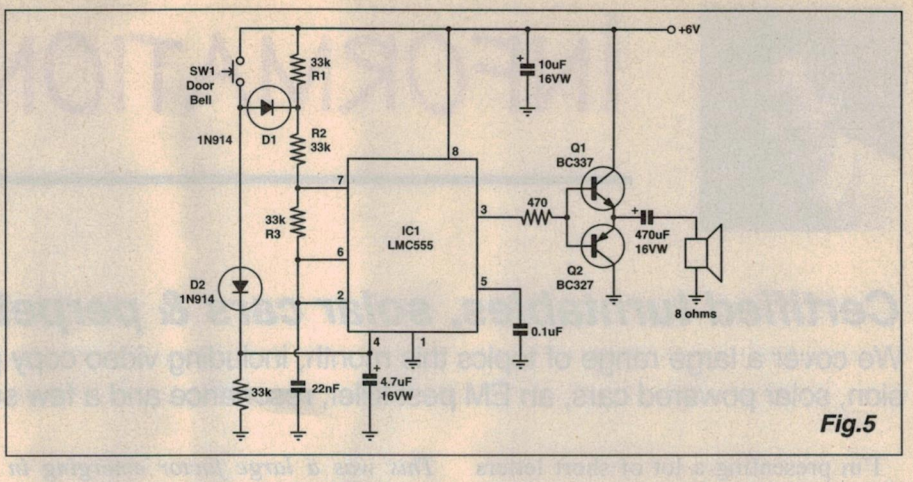


Fig.5

Rain Synthesiser

There's no doubt that sound effects circuits can be a lot of fun. They're also pretty quick and easy to do. The circuit in Fig.4 is a 'quick and dirty' rain synthesiser. In fact, it's just a simple extension to the circuit from Fig.1. All it really adds is a passive filter network which can be varied to produce different sounds via the 100k potentiometer.

With the pot wound to minimum resistance, low frequency noise makes up the bulk of the signal and sounds like a wild rain storm — while the opposite end will give you a 'light spring shower' effect. Again, you can connect the output to a small amplifier or a cassette deck if you so desire. The output may be a bit high for the latter, so watch the recording levels.

Two-tone doorbell

While random noise generator circuits can have a soothing effect, there are times when you just want to grab people's attention.

The circuit in Fig.4 is a modification on a fairly standard circuit which has been around for quite some time. While many of you may have seen the basics of it before, it really is a very good circuit making good use of every component. It's a very basic two-tone doorbell which uses the CMOS version of our old friend, the 555 timer IC.

Looking at Fig.4, the LMC555 IC is connected up as an astable oscillator with a slight twist. Normally the reset input of pin 4 is tied to the supply rail so that the IC works straight away. However, in our circuit, the reset input is only pulled high when the doorbell switch SW1 is pressed. This sends a flow of current to charge up the 4.7uF capacitor via diode D2. The resistor across the capacitor ensures that when the switch is released, the IC remains active for that time constant — which is around a couple of seconds.

What also happens when SW1 is pressed is that +6V is also connected via diode D1 to the bottom end of 33kΩ resistor R1. Now this resistor is one of the main frequency-determining components for the timer IC; however when the switch is pressed, this resistor is bypassed so that only resistors R2 and R3 (as well as capacitor C2) set the tone. When the switch is released, resistor R1 drops back in to play and this causes the tone frequency to drop — giving you the famous 'ding-dong' effect.

After a small time, the RC time constant on the reset pin discharges and turns the IC off, stopping the tone altogether.

Since the CMOS 555 timer is not high in output power, the simple two-transistor output stage gives the signal a bit more punch through the speaker. I suggest also putting a small baffle around the speaker. This can be as simple as a roll of paper around the speaker frame. Without going into all the details now, it's a simple way of making the whole circuit sound louder.

The benefit of using the CMOS circuit over the standard 555 timer is that this circuit doesn't require a power switch. This is because when the circuit isn't being used, the current drain is negligible — a few tens of microamps.

You could quite easily adapt this circuit as your main doorbell unit at home. The beauty of this is that if the circuit ever fails, you'll be able to fix it easily without throwing away your hard-earned. Commercial doorbells may sound better and be cheaper, but you learn very little by giving someone else your money.

Tape Noise Limiter

Finally, I thought that seeing most of this month's circuits deal with *making* noise, I should balance it up a little by including a circuit which is designed to *remove* it. This Tape Noise Limiter circuit (Fig.6) may not be hi-fi in quality, but it's ideal for removing unwanted hiss from old mono tapes or records you may have as part of your collection.

The main time you really recognise noise is when there is a lull in the audio program, not when the audio level is at its peak.

The beauty of this circuit, apart from only using garden-variety transistors, is that it only acts when the signal level is low, — i.e., when there's no action. Once the main sound of the tape appears, the circuit progressively switches off, allowing the whole audio spectrum to pass by as it would normally.

Looking at Fig.6, the input audio signal is immediately split into two paths. One is the straight audio path, via the 4.7k resistor, while the other creates a DC control signal from the AC audio signal.

Continued on page 79

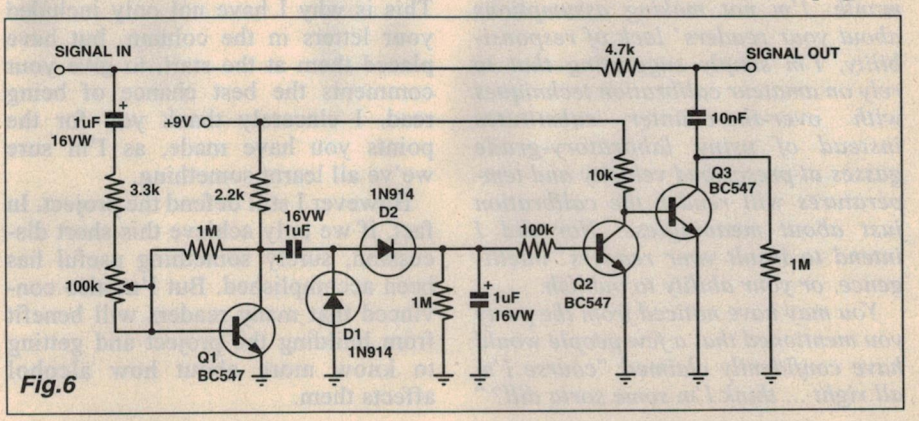
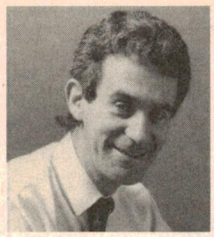


Fig.6



INFORMATION CENTRE

by PETER PHILLIPS

Certified turntables, solar cars & perpetual motion

We cover a large range of topics this month, including video copy protection, microcontrollers, corrosion, solar powered cars, an EM pest killer, resonance and a few surprises. Something for everyone!

I'm presenting a lot of short letters this month, to counter my recent tendency of presenting in-depth discussions on a few issues only. This not only lets me clear my desk, but allows more readers to have their say. Even so, I still have a lot more letters, which I hope to present soon. So if your letter misses out this month, please be patient — I'll do my best to clear the backlog next month. And of course, my thanks to all those who have written. Without you there would be no column.

Our first letter is from the reader who inspired my opening comments last month. You might recall that the writer regarded our October '96 Alcohol Breath Tester as being "positively dangerous". My response was to question whether readers would be likely to rely on the device as a means of testing their blood alcohol content (BAC) before driving. I also claimed that readers able to build and calibrate such a device are likely to be sufficiently responsible to use the device with the caution mentioned in the article.

While the following letter doesn't change my opinion, it makes a number of points I think you'll find interesting.

Breath tester

I'm mildly critical of your comments about my letter that you published last month. I'm not making assumptions about your readers' lack of responsibility, I'm simply suggesting that to rely on amateur calibration techniques with over-the-counter substitutes instead of using laboratory-grade gasses at prescribed velocity and temperatures will render the calibration just about meaningless. Nor did I intend to insult your readers' intelligence, or your ability to publish.

You may have noticed from the party you mentioned that a few people would have confidently claimed "course I'm all right ... think I'm some sorta dill?" This was a large factor emerging in our R&D of 15 years ago. Increasing inebriation causes many people to misjudge their ability, and their consequent actions are compounded by several psychological factors.

My point is that otherwise responsible people do some very silly things once their BAC exceeds around 0.022%. This is why the limits are different for young and inexperienced drivers. I'd like to see a national limit of 0.035%, with three convictions meaning you're out for life (as in Germany). I suspect insurance companies would approve.

Although I'm not in a position at this stage to find and send you the design I referred to, we were able to beat the need for frequent calibration. In fact annual calibration was fine, with a small increase in sensitivity. In the interim, best regards. (Peter Lucock, Wynnum West, Qld)

I guess we will have to agree to disagree on this, Peter. From what you say, even if a person has an accurate means of testing their BAC, they will not do so once their BAC exceeds around 0.02%. That is, it doesn't matter how good the device, it's the person's BAC that makes all the difference.

You are obviously experienced in this topic, and have done far more research than I am ever likely to do. This is why I have not only included your letters in the column, but have placed them at the start, to give your comments the best chance of being read. I sincerely thank you for the points you have made, as I'm sure we've all learnt something.

However I still defend the project. In fact, if we only achieve this short discussion, surely something useful has been accomplished. But I'm also convinced that many readers will benefit from building the project and getting to know more about how alcohol affects them.

Macrovision copy protection

In the July issue, I included a letter from a reader (Tony Antoniou) concerning the Macrovision copy protection system used on some rental videos. The letter gave a Web page address containing more information, but it appears from the following letter that this address was incorrect:

I read with interest your July '96 column, in particular the segment concerning video copy protection. I have noticed picture degradation where Macrovision protection is used and am interested in a way around the problem. Your correspondent said he had a circuit, which I would like to see. I tried the Web page mentioned in the letter, but to no avail. Can you help? (Jon Ellis, Norah Head, NSW)

As it turns out Jon, I can. Just read the next letter, which gives the correct address.

I have been informed that the URL of my version of the Macrovision system (video tape copy protection) was incorrectly given. The correct URL is: **http://www.paranoia.com/filipg/HTML/LINK/F_MacroVision.html**

The case is important, and needs to be as shown. (Filip M Gieszczykiewicz)

This message came from our bulletin board. Thanks Filip for the correction, although such a complex address is likely to fox almost anyone!

So if you're keen to know more about the Macrovision protection system, just be sure to type this address correctly, and hopefully you'll find the required information.

Stereo cartridge testing

We don't get many questions these days about record players, which is the first topic of the following letter. The second is about PAL versus NTSC, which I've certainly been asked about before.

I'm writing for help on a number of issues. First, how do you test a stereo record cartridge to confirm if the left and right channels are working, and what instrument should be used?

Secondly, is it possible to construct a wave transformer to convert a TV from Japan in NTSC format to PAL format? If so, can you please provide me with the necessary specifications and calculations. (John Raheb, Leederville, WA)

A stereo pickup cartridge has two sensing elements. The illustration in Fig.1 shows the basic assembly of a piezo cartridge (crystal or ceramic), in which the movement of the stylus is transmitted to the crystal elements via a pliable diamond shaped 'resolver'. A magnetic cartridge has two coils instead of two crystal elements, again linked to a common stylus. The major differences between a crystal (ceramic) and a magnetic cartridge are the output level of the signal, and the frequency compensation required.

The simplest way to test such a cartridge is with an audio amplifier. Connect the amplifier to one output of the cartridge and gently wriggle the stylus with a finger. Repeat this test for the other output. If you get a reasonable sound output from the cartridge from both channels, it's probably OK.

However the output from a magnetic cartridge is considerably less than that from a ceramic cartridge, so you'll need an amplifier with an input for a magnetic cartridge if you are testing this type of device. It's that simple John. No fancy test gear is needed, unless you want to confirm that each channel is delivering the same output level. Then you'll need a test record and an oscilloscope.

I'm not sure what you mean by a 'wave' transformer, but in any case you'll need far more than a transformer to convert an NTSC receiver to PAL. The major differences between the two systems are field and horizontal and colour subcarrier frequencies and, of course, the alternate line colour switching system inherent in PAL but absent in NTSC.

EM pest killer

In January I described a device claimed to kill household pests by EM radiation. On the basis of its power output, I agreed with the reader who sent me the information that the device was unlikely to be able to live up to the claims made in the advertisement. However, the following letter gives evidence to the contrary.

I notice your condemnation of an EM pest killer in the January 1997 issue. Well, it may be a case of don't knock it until you've tried it. For almost 20 years I have had a problem with ants in my kitchen and adjacent bathroom. We tried surface sprays — the ants returned. We tried a gel that when eaten by roving ants kills others in the nest who eat those killed by the gel. The ants returned. Next we tried a pest extermination company who sprayed the cupboards, but the ants returned. We removed wall panelling in the bathroom and put poison in the wall cavity — the ants returned.

A year ago, in desperation and as a cynical last resort I bought a device like the one you referred to in your January column, as the $80 price tag was nothing compared to what I'd already spent. And guess what? The ants are gone!

'Consumerism at its worst' it may be, but I'll put up with the EM field this device emits as it has to be less harmful than the poisons we've used over the years. And no, I don't believe the poisons have now taken effect, as the ants would have been dead long ago.

Rather than knocking something that just might work, perhaps your team should spend more time proofreading the magazine (where are the graphs for the VAF speaker kits on page 73?) plus other 'typos' in this issue. (Brad Sheargold, Collaroy, NSW)

Perhaps I didn't make it clear, Brad, that this low power (7W) device is claimed to protect an entire house of virtually all pests, including large spiders. Given that the EM radiation is transmitted via the house wiring, and that some pests are supposed to be able to withstand the effects of a nuclear bomb, it strikes me as being somewhat impossible. However, I take your point that you have found it got rid of ants; I assume you have placed the device close to where the ants used to enter your house.

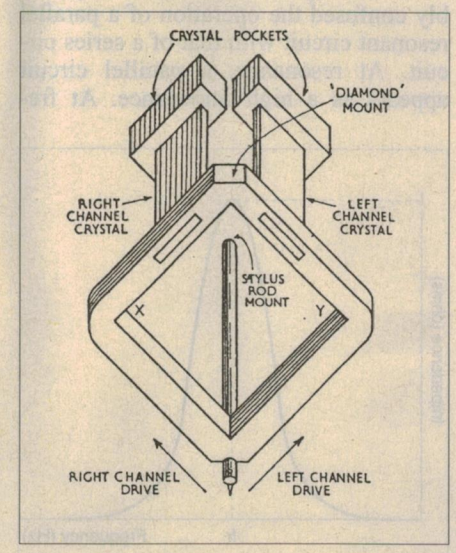


Fig.1: A stereo record player cartridge has two sensors (in this case crystals), linked by a 'resolver' to a single stylus.

But is your experience evidence for the claims made about this device? For instance, are all parts of your home free of roving nasties such as cockroaches? These are the claims that I contest. And I notice you too refer to the device as a 'cynical last resort'.

However, while I still believe the claims for the device are exaggerated, I bow to your experience and pass it on to other readers. As for spending more time proofreading, I assure you that even the most prestigious publications have errors from time to time, regardless of how many people proof it. It's a fact of publishing life.

Perpetual motion

If you wanted to build the anti-gravity airship described last month, but were put off by its sheer physical size, perhaps you could try this design.

Your anti-gravity item in the December issue reminded me of an article I recently read in one of the larger newspapers. Some of the discussion was attributed to New Scientist, which in essence propounded a perpetual motion device based on an anti-gravity force. It went something like this:

(a) It is well known that a cat always falls on its feet when dropped; and (b) a slice of buttered toast nearly always falls butter-side down. The device outlined comprises a cat with a slice of buttered toast fastened to its back. By virtue of (a) and (b), this assembly cannot hit the floor when dropped. Instead it will hover just above the floor, spinning as the two repulsion forces come into play. A number of such assemblies can be coupled together to generate power — indeed it's possible that the humming noise associated with UFOs is actually pussy cats purring.

The item discussed the fact that the probability of toast landing butter-side upward is inversely proportional to the cost of the carpet. This introduces a factor that may involve too great an expenditure to effect economical and reliable operation. Some doubts were raised about the possibility of the moggy managing to eat the toast. (Ron Voller, St Georges Basin, NSW)

The flaw in this design, as any astute reader will note, is that butter is absorbed into the toast. Use marmalade or honey, it's far more reliable! (Just kidding, younger readers — see Mum or Dad before attempting this construction.)

68HC11 microcontroller

I included a letter in the December column from a reader (Jeffrey Renwick, Mt Eliza, Vic) asking about projects based on the Motorola 68HC11 microcontroller. As we've not developed any projects based on this chip, I'm pleased to present two letters that give details of where to find more information about the 'HC11:

I too am interested in projects based on the MC68HC11 microcontroller. I suggest that Jeffrey examine the book 'Mobile Robots' by Joseph L Jones and Anita M Flynn (published by A K Peters Ltd ISBN 1-56881-011-3). The book deals only with the MC68HC11 microcontroller and how to interface various input and output devices to it, as the authors describe the construction of a fun little robot (Rug Warrior). I ordered my copy through the ANU Bookshop in Canberra, but it's also available direct from the Mondo-Tronics Robot Store in California (URL: **http://www.robotstore.com***). Mondo-Tronics also sell complete robot kits based on the MC68HC11 chip. I still haven't found a supplier in Australia that stocks this chip, so I guess I'll have to import them from the USA.*

Another excellent book is 'The Microcontroller Idea Book' by Jan Axelson (Lakeview Research, ISBN 0-9650819-0-7) that features the Intel 8052-BASIC single-chip computer (another chip unavailable in Australia). The real value of this book is the collection of input/output circuits that show how to connect a microcontroller to the outside world. Once you know how to do it, you can use the circuits cookbook-style. I'd like to see EA do more in the area of small robotics, as it's an excellent way to learn about computer hardware and software interfacing, based on the MC68HC11 of course! (Rob Moulis, Hackett, ACT)

Thank you for this information, Rob. I guess there are many people who have got into microcontrollers and the like through building small robots. Our last robot project was in 1986, so perhaps it's time for us to consider another one.

Here's the next letter, which questions whether the 'HC11 is the right way to go.

In reference to Jeffery Renwick's letter regarding the 68HC11, I can recommend a book called 'Design with Microcontrollers' by John B Peatman, which can be ordered through the University Co-Op Bookshop. However the 'HC11 is a more complex device than the 'HC05. The development system costs are higher and development times are longer.

I recently bought the 68HC705 development system from Oztechnics. It's fantastic and has given me the resources I needed to complement my existing knowledge and books on Motorola processors. So Jeffery, maybe the 'HC05 will do the job just as well as the 'HC11, but with less cost and complexity. (Salvatore Sidoti, Lilyfield, NSW)

I tend to agree with you, Salvatore. I don't know much about the 'HC11, but I'm familiar with the 'HC05 and consider it a reasonably powerful controller. So given the locally available development package from Oztechnics, it might be a better way to go.

Parallel resonance

Our next correspondent cannot see how the Miracle AM antenna can possibly work...

Concerning the Miracle AM antenna in the November 1996 issue. The circuit on page 59 shows, what appears to me, the tuning inductor (antenna) in parallel with the tuning capacitor (varicap diodes). My understanding is that the resonant frequency would be the only one rejected, and all others would pass to the receiver. Where have I gone wrong? (Gordon Gosbell, Pendle Hill, NSW)

Your interpretation of the circuit is correct Gordon, the inductor and capacitor form a parallel LC circuit tuned to a particular frequency by the capacitance of the varicap diodes. But you've possibly confused the operation of a parallel resonant circuit with that of a series circuit. At resonance, a parallel circuit appears as a high impedance. At frequencies either side of resonance, the impedance drops, as shown in Fig.2.

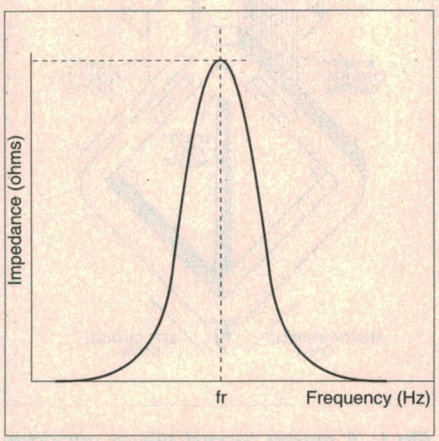


Fig.2: The impedance of a parallel resonant circuit is a maximum at resonance.

Now consider the effect this has on the range of incoming signals. In theory, the antenna is exposed to an almost infinite range of frequencies, of which only one is required. The signal that is accepted and passed on to the amplifier is the signal that causes resonance, because at all other frequencies the LC network appears as a low impedance. These signals are therefore bypassed (or 'shorted out') by the resonant circuit.

In a series resonance circuit the impedance of the circuit at resonance is a minimum. While such a circuit could be used, the varicap diodes would need to be above earth, making the design more difficult.

Marching girls

I said there would be variety in this month's column! I could have used a different heading such as 'certified turntables', but — oh well, read on:

I have noticed discussion in your column about changing the speed of a CD player. This reminds me of a conversation I had many years ago with a man who coached marching girls. He was very concerned that the tempo of the music should be exact, and always the same from one rehearsal to the next. While I don't know much about marching girls, I assume the tempo determines how far the girls will march in a given time, of possible importance in closely timed events. He talked of obtaining a 'certified turntable', which I imagine has a speed independent of the mains frequency.

So, what is/was a 'certified turntable' and what authority certified them? Also, is there any indication of a speed variation between different CD players, as is the case for turntables, and of course most tape players? In other words, do marching girl trainers still have a problem? (M. Gamble, South Yarra, Vic)

Like you, Mr Gamble, my only knowledge of marching girls is from parades, where the music is usually provided by a brass band. The tempo is therefore up to the conductor. But given that there are contests, I can imagine tempo would be very important. I haven't heard of a 'certified turntable', so I wonder if someone might enlighten us.

Regarding the speed of a CD player, I have found little variation in the musical pitch of an item on a CD, regardless of the machine it's played on. Because pitch is related to tempo, then I would

say there is a high degree of consistency between CD players.

In a CD player the platter speed actually varies quite a lot. The data from the CD is fed to a buffer, and the speed of rotation is varied to keep the buffer more or less full. The data is taken from the buffer at a rate determined by the sampling electronics, which in turn is controlled by a crystal oscillator. So given that crystals are sufficiently accurate to operate a wristwatch, it's reasonable to suggest that marching girl trainers no longer have a problem — at least with the tempo of a CD recording.

Corrosion

In December, a reader who lived closed to the sea asked about the effects of corrosion on an aluminium antenna mast bolted to a galvanised bracket. I replied that there's likely to be a chemical reaction between the two metals, and based on my experience, suggested painting the bracket with a quality primer. However, as my antenna installation is 15km or so from the sea, I was most interested to get the following letter, which is from a reader who lives much closer to the sea.

I have had an isopole 144 antenna in use since 1985 that is mounted on a 30mm aluminium mast. This mast is attached with three hose clamps to a 30mm four metre length of galvanised waterpipe. So far there is no corrosion between the two masts, even though my house is about 5km from the beach. I do have a fairly substantial earth wire attached to the aluminium mast which goes directly to ground underneath the galvanised mast. (Ken Watson, Nambucca Heads, NSW)

As I said in December, I have a limited knowledge of chemical reactions between metals, so it's good to hear from readers with a similar installation to that required by our December correspondent. Thanks Ken, for sending me this information.

Solar powered car

The next letter comes from a 13 year old reader who wants help in designing a solar powered car.

I admire your magazine and also this column, because there is always has a useful titbit of information. I am considering going in the Australian solar model car competition held each year at ScienceWorks (in Victoria) and other locations elsewhere in Australia. The championships are then held in a particular state, this year in Adelaide. Only high school students can enter.

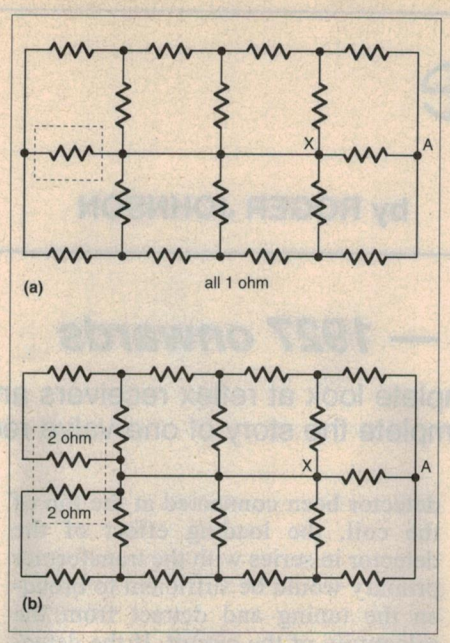


Fig.3: The original circuit (top) for February's What? can be redrawn as shown, giving two separate networks in parallel.

I had an idea which would keep the solar panel's output to the motor at a full 12V at all times, by sensing if it falls below 12V, pushing it up until it hits 12V, letting go, and so on, so a pulsing action would be achieved.

The only thing is, I am not very proficient at circuit design, (but I'm working on it!) and I thought maybe I could ask you to whip me up a quick design, so I could get my idea onto a printed circuit board. (Roger Close, Mulgrave, Vic)

Thanks for you comments about the magazine Roger, and for your confidence in our skills at 'whipping up' a circuit design. Oddly enough I've never thought about it, but are you allowed a battery in a solar powered car? This of course makes a huge difference to the design of the circuit.

Rather than spend the necessary weeks perfecting such a design (you just don't whip 'em up, Roger), I'm referring you to two possible designs that might help. The first is in the November and December '94 issues, in which we presented a solar panel charger. This circuit has all the necessary regulation on board to correctly charge a 12V battery. But this design requires a battery.

The second comes from February 1992. This design uses a 'charge pump' circuit to boost the output from a solar panel in the way you describe. Note that resistor R1 should be 180k and R2 should be 22Ω, not 180Ω and 220Ω as shown on the circuit. However, as you don't give me any indication of the size of the motor you want to use, I can't be sure if this circuit will deliver enough current.

As you will see when you read the articles, the designs come from Oatley Electronics, who might be able to give you more help. Good luck in the competition.

What??

We haven't had a question on switching for a while, so I'm glad to be able to present this one, which comes from Graham Leadbeater (Ringwood, Vic). Graham asks:

You have two flood lights in the garden, individually controlled by two switches in the house. Because these lights are often inadvertently left on all night, you decide to fit a neon pilot light to the switch panel to show if either one, or both lights are on.

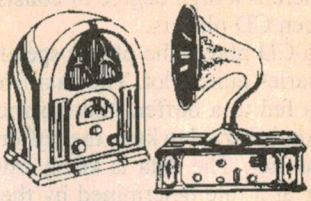
You only have one neon lamp, and because a double-pole switch is too expensive (and hard to get) you need to use the existing single pole, double throw switches that control the garden lights. You cannot use any other components (relays etc) as there's no room behind the switch panel. What is the circuit to achieve this? Lateral thinking will help here!

Answer to February's What

The resistance is 0.448 ohms, which Charlie Worsfold (contributor of the question) found by using the circuit simulator program Electronics Workbench. While there are probably lots of ways to solve the problem, my way was to redraw the circuit as shown in Fig.3(a), then to simplify it. Given the symmetry of the circuit, it can be redrawn as in Fig.3(b) where one resistor is replaced by two, 2Ω resistors. This then separates the two sections, and the resistance of each network can be found. The total resistance between points A and X is then the two network resistances in parallel. The actual value goes for many decimal points, but rounds off to 0.448 ohms. ❖

Vintage Radio

by ROGER JOHNSON



One valve receivers — 1927 onwards

This month we take a more complete look at reflex receivers and also at other sets which used single multiple-use valves, to complete the story of one-valve receivers.

The idea of a single-valve reflex receiver was more often than not to enable the valve to be an RF amplifier as well as an audio amplifier, thereby enabling two tuning circuits instead of the usual one tuning circuit. This also meant dispensing with a reaction winding, which was seen by some as a blessing.

Whilst this was usually the case, it wasn't always so — as the circuit in Fig.1 shows. This circuit was taken from *Wireless Weekly* for October 21st, 1927. The text is very specific about panel layout, how to solder and many peripheral issues, but is remarkably devoid of how the beast actually works. The text claims that the valve acts as an RF amplifier, but only inasmuch that it provides an amplified RF signal for the purposes of regeneration.

The circuit contains some tricky features. The grid capacitor is given as 0.002uF (2nF), which represents an impedance of about 80 ohms at a nominal 1MHz. Assuming the secondary of a 5:1 audio transformer to have an inductance in the order of 4 - 5 Henrys, the inductive impedance at the nominal 1MHz is within the range of 30 - 32 megohms. Clearly, the incoming RF from the tuned circuit will only be slightly impeded by the capacitor. The choice of the value of this capacitor is important, for reasons to be explained later.

Not shown in the actual circuit diagram, but explained in the text, is the fact that the reaction winding is variably coupled to the main tuning circuit. The valve, therefore, is doing no more at this stage than a standard Reinartz regeneration circuit.

Detection

The crystal detector (a 'Harlie' unit was recommended) is connected midway down the tuning coil. Had the detector been connected at the top of the coil, the loading effect of the detector in series with the transformer primary would be sufficient to broaden the tuning and detract from the selectivity of the circuit. If the detector was placed lower down the coil, it would be nearer the earth end with a consequent loss in signal level available at the detector.

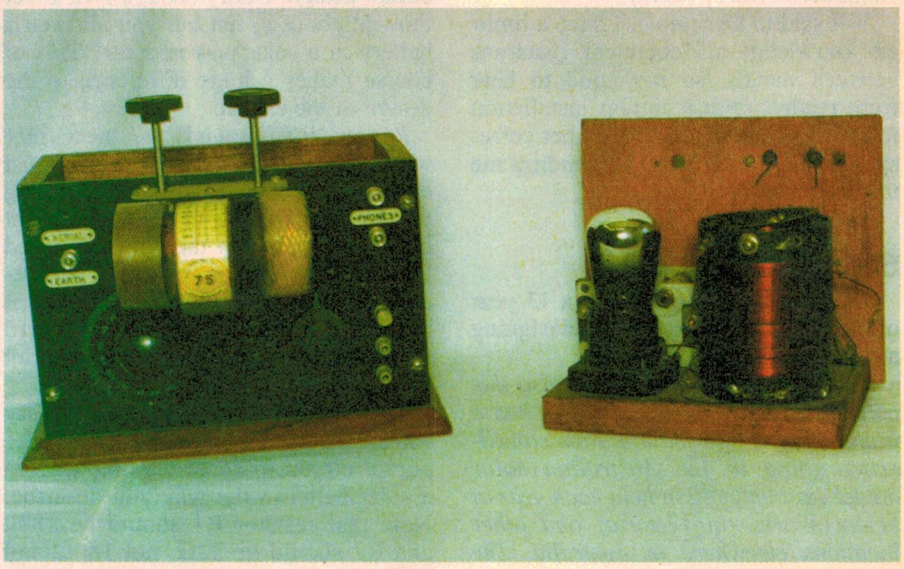
From the detector, which incidentally is shown to pass the negative half cycles, the primary of the audio transformer is excited and the voltage stepped up according to the ratio. The secondary of the transformer is connected to the grid of the valve and to earth via the secondary of the tuning coil, and shunted with the RF bypass capacitor referred to above.

Choice of valve

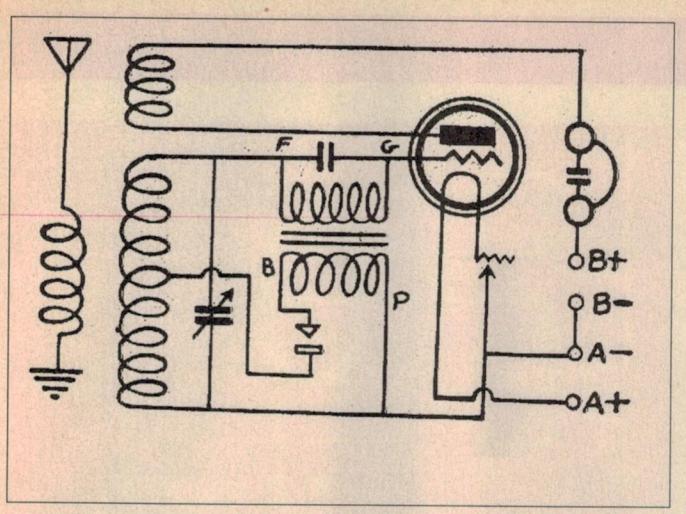
The text explains that results will depend upon the choice of valve. It states that a valve must be chosen that 'has a characteristic curve with a good straight portion', since the valve must not act as a detector (quite correct!). To achieve that end, the use of the filament rheostat is important.

The filament rheostat will alter the operating characteristics of the valve for each setting. There may well be a setting where the characteristic curve so produced has a more linear portion than at another setting. Altering the rheostat controls the emission, which in turn will alter the gain and the amount of RF signal fed back to the tuning circuit — so that operating this one-valver becomes a juggling match between rheostat, reaction and adjustment of the crystal detector! It is claimed that with 120 volts B+, this set will operate a loudspeaker (i.e., a horn speaker) on the stronger stations.

But let's turn back to that 2nF input capacitor across the audio transformer secondary. With the approximate inductance of the secondary winding



Two sets typical of the many home constructed one-valvers of the 1930s and 1940s. The little radio on the left almost certainly started life as a crystal set.



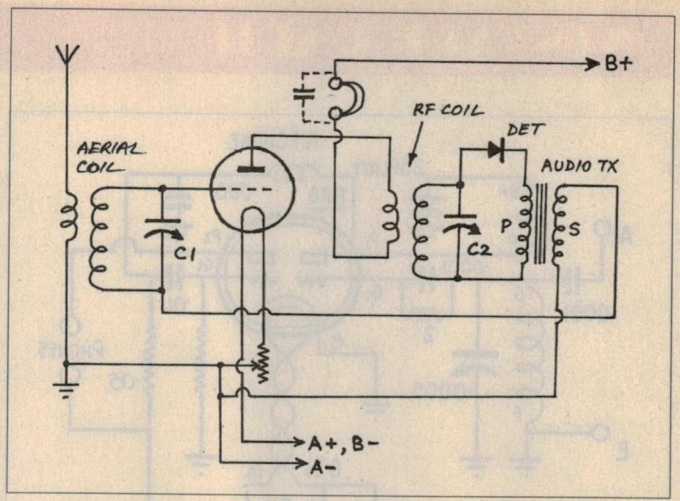


Fig.1 (left): This somewhat odd reflex/regenerative circuit appeared in 'Wireless Weekly' for October 21st, 1927. How the circuit works and how critical some of the component values were is explained in the text. Fig.2 (right): This more conventional one-valve reflex circuit is taken from a handwritten notebook of about 1927. Its performance could probably be improved by adding an RF bypass capacitor across the audio transformer secondary winding.

of (say) 4 - 5 Henries, and seeing that the inductance acts as an EMF generator, this setup may well act as a low-pass filter with the cut-off point in the range, depending upon the inductance, of about 3.0 - 3.2kHz.

If the input capacitor was lower in value, the cut-off frequency will certainly be raised, but the impedance to the RF input will also rise with a consequent loss in signal to the grid. If the capacitance is made larger, the opposite occurs, placing the low-pass cut-off well within the frequency range of the speaker and resulting in an even more unpleasant sound, if that is possible!

In the final analysis, this circuit would only have the theoretical advantage of a voltage gain afforded by the audio transformer: a whole 14dB. Given that the valve must be reduced in operating conditions, and hence gain, one wonders where the advantage of this circuit was when compared with a well designed Reinartz circuit operating under maximum conditions.

Another reflex circuit

The circuit of Fig.2, also from 1927, is more what reflexing is all about. It contains two tuned circuits, and the regeneration winding is eliminated — which as noted earlier would be seen by some as a blessing.

In this circuit the valve really does act as both an RF amplifier and an audio amplifier. The antenna is coupled to the first tuning coil in the normal manner, but the tuning circuit is returned to earth via the secondary of the audio transformer. Typically, this has a DC resistance of the order of 5kΩ, and there will be some signal loss as a result.

Following the first tuned circuit, the RF signal is fed straight to the grid of the valve where it is amplified, and appears in the primary of the 'RF coil'. There, it is inductively coupled to the secondary of the tuned RF coil.

From the 'top' of the RF coil secondary, the signal is detected (demodulated) by the crystal detector and passed to the primary of the audio transformer. This winding is returned to the 'bottom' or 'cold' end of the RF tuned circuit, such that the detector and primary of the audio transformer shunt the RF coil secondary. This may have a loading effect on the tuned circuit, which would result in broadening the tuning.

Once the audio component has been fed back into the grid, the valve acts as an audio amplifier.

You will notice the headphone/speaker jack in the plate circuit, between the primary of the RF coil and B+. The primary of the RF coil has no effect at audio frequencies, because its inductance is very low.

The valve is effectively cathode biased, by an amount equal to the voltage drop across the filament rheostat.

Dual-purpose valves

In the period from mid 1934 to mid 1935, advances in valve technology saw the release of valves such as duo-diode triodes, pentagrid converters and dual triodes designed for push-pull class B output. These were principally the type 6A6, (later metal type 6N7) for AC operation, and type 19 and Philips B240 for all-battery operation.

The battery types were used by radio set manufacturers in class-B push-pull output, because a considerable saving in battery current was afforded at low-level listening, and also second harmonic distortion was eliminated — thereby giving a better 'tone'. The AC twin triode 6A6 did not seem to gain favour with radio set manufacturers, in this country at least.

'Little Jim'

In *Wireless Weekly* for May 27th 1938, the late John Moyle described a single valve battery set for headphone operation, and called this set 'Little Jim'. It was described quite specifically in order to listen to the latest thing: the direct broadcasts of the Test Matches from England, 'whilst snug in bed'!

John Moyle was quite serious about the anticipated appeal of this set, because fully six pages of text, illustrations and photographs were devoted to its construction. The valve used was the seemingly forgotten type 6A6 twin triode, a fully imported valve and presumably there were plenty in stock because of its disfavour with radio set manufacturers.

The circuit was not a technical marvel (Fig.3). Merely a regenerative detector resistance coupled to an audio stage, the set had a self contained 45 volt B-battery and the valve heater was powered from a small 6.3 volt mains transformer. Because the total current drain was only about one milliamp, battery life was expected to be little short of shelf life.

The all-battery equivalent was

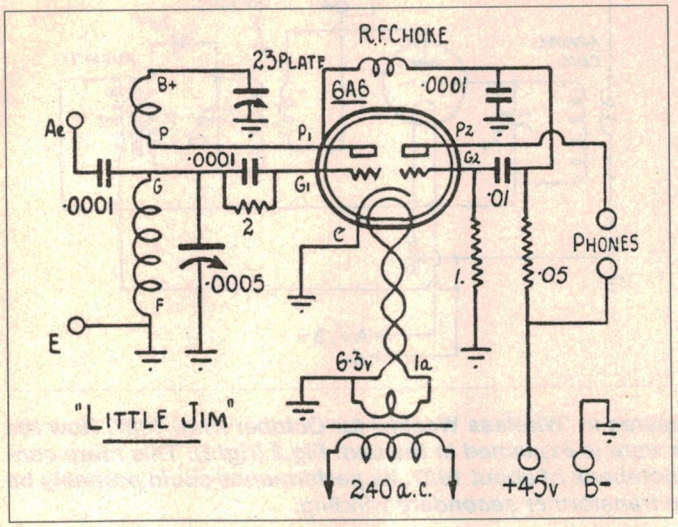


Fig.3: The circuit for John Moyle's original 'Little Jim' one valve receiver, published in 'Wireless Weekly' for May 27, 1938. It uses only regeneration, not reflexing.

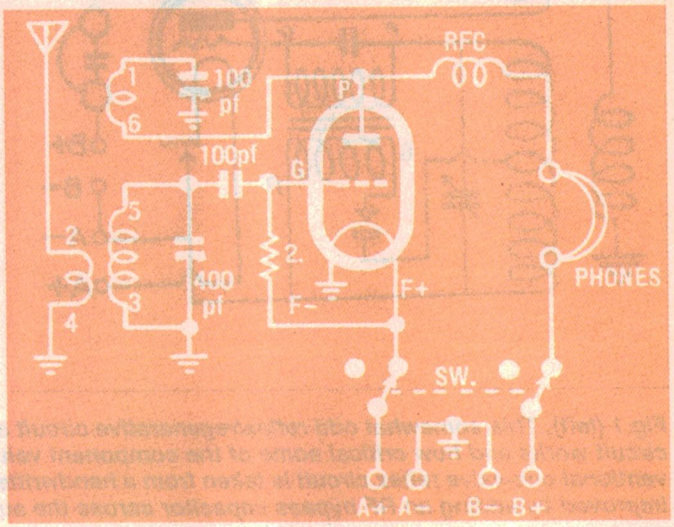


Fig.4: The circuit for a one-valver intended as a training exercise for a beginner, described in 'Radio and Hobbies' for September 1954.

described in *Wireless Weekly* for June 10th, 1938, but was not nearly so complete in its description — concentrating instead on valve types and how to power them. One suggestion was to use a type 19 twin triode and power it from a 2V accumulator which was kept under the bed.

The follow-up article explained that for 'the country man' reception might be improved by resorting to a large outside aerial, rather than the wire spring of the bed base(!), and by increasing the B+ to 60 volts. The article went on to advise country constructors not to expect 'Little Jim's Mate' (was that Stan?) to do what a larger five-valve superhet could not.

'Little Jim' and his mate were revised and updated in 1939, 1941, 1946/7 and 1952/3. The 1939 rebuilds appeared in the very first two issues of *Radio and Hobbies*, viz. April and May 1939. The battery version for May 1939 used a type 19, or the octal equivalent type 1J6-G, but powering the filament from a large 1.5 volt bell battery. Obviously, experiments showed that there was enough emission even with 1.5V on the filament for the valve to satisfactorily oscillate over the entire broadcast band.

During the war years it seemed that there was demand for a cheap, economical, reliable and compact headphone set for use by servicemen whilst living in barracks, so another version appeared in 1941. This time the 'electric' version employed the mixer/converter valve type 6J8-G. The heptode/mixer portion was triode connected and served as the detector portion, and the oscillator triode section served as the audio amplifier. The 6J8-G was chosen because the types 6A6 (6N7), 6F7, 6C8-G or 6F8-G were all imported valves and were no longer available because of wartime restrictions — whereas the 6J8-G was locally made.

A training exercise

Ever since the early 1930s, when a second-hand or obsolete valve type such as an old (2)01-A could be purchased for a 'few bob' (30 or 40 cents) rather than a 'quid' (a pound note, nominally equal in value to today's $2 coin), numerous one-valve Reinartz circuits have been described particularly for novices.

For very little outlay, a valve radio could be constructed which gave result much superior to a crystal set. The other aspect of describing such sets was to introduce the initiate to the 'big time' of a valve radio. Once the one-valve Reinartz set was mastered, the sky was the limit!

One of the very last such articles was described in the September 1954 edition of *Radio and Hobbies*, and the circuit appears in Fig.4. It could be easily built today, with satisfactory results.

The 'Hikers One'

The story of one valve radios would not be complete without mention of this particular set. This unusual little one-valver completes the story of one valve radios and has been fully covered by Peter Lankshear in this column in *EA* for October 1989.

In summary, there is quite a lot of fun to be had with the humble one-valver. If anyone has on hand a working audio transformer, and has the necessary means to wind the coils, why not have an attempt at a reflex set, using a modern solid state signal diode? The results could be interesting. ❖

EXPERIMENTING

Continued from page 71

First stop on the way is transistor Q1. This provides some raw amplification. If you had a look at the output, I don't think it would look all that pretty but we don't need this part of the signal to look good. All we need is copious amounts of that signal.

Next stop is a voltage rectifier and diode pump, formed around diodes D1 and D2. These rectify the AC signal and feed the reservoir capacitor C1. The DC voltage here is proportional to the overall amplitude of the main audio signal.

This DC voltage is then fed onto transistor Q2, whose basic task is to invert the signal so that it can be fed to transistor Q3.

From our wave sound circuit in Fig.3, we know that a voltage-controlled resistor is a resistor whose resistance can be varied in proportion to a control voltage. In following with the fairly basic nature of our circuit, we're using Q3 here as our voltage-controlled resistor; however, if we were more accurate, we'd probably have to call it a voltage controlled switch.

Ordinary bipolar junction transistors such as the BC547 are not the best components for using as voltage controlled resistors, but they're cheap — and in this instance, they'll do.

With a low input signal, the diode pump has little to feed the reservoir capacitor so there's no DC voltage to drive Q2. This means that Q3 is biased on, pulling the 10nF filter capacitor into play and removing the unwanted noise from the audio we want to hear.

When the signal level rises, Q1 amplifies the signal and the resulting DC voltage from the diode pump fills up C1. This turns on Q2 which then turns Q3 off, pulling the filter capacitor out of action and allowing the audio to flow through to the output unimpeded.

The circuit works nicely off a 9V battery, however you could go down to as low as 6V without too many worries. Just make sure that you get plenty of signal when you need it from the collector of Q1, otherwise you won't get enough DC voltage to turn the filter off when you don't need it.

OK, that's enough for this month. We'll look at a few more complicated sound effects and animal-noise circuits next month. ❖

Alarm for Car Systems

Continued from page50

Positive earth mods

Modification for positive earth vehicles is fairly straightforward and is illustrated in Fig.4. A couple of extra tracks and pads are provided on the PCB to make the modification easier. You will also need to cut three tracks as marked in the figure. Be sure also to connect vehicle ground (which is +12V) to the '+V' input of the circuit. The circuit's '-V' input should be connected to a line that is live even when the ignition is off.

Otherwise, all the other connections are the same. The shorting links required on J1 will also be different for positive earth vehicles, and should be the opposite of what I have described for the setup above with my negative earth vehicle.

As mentioned, the main problem you are likely to run into is simply working out how your vehicle's wiring is set up and the location of engine sensors. I managed to work mine out with just a bit of guesswork and prodding, but if the going gets tough, you might need to resort to technical manuals on your vehicle.

If you don't have any luck getting these from your local dealer, Jon Loughron who writes the regular automotive electronics column for *EA* advises that manuals are available for many makes from Peter Kurtner of Da Vinci Books, on (041) 203 5129.

I wish to gratefully acknowledge the help of Jon Loughron, who provided advice on the types of sensor and electrical systems in modern vehicles, and Bob Tate of Robert Bosch Australia who also helped out on this topic. ❖

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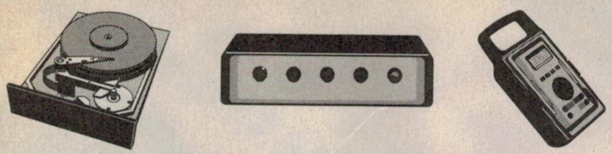

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NOTES & ERRATA

RF Test Oscillator (May/June 1996):
The PCB overlay diagrams have a number of errors:
1. C29 (22nF) is incorrectly identified as C30
2. C26 (0.1uF) is incorrectly identified as C29
3. C30 (0.1uF) is incorrectly identified as C31
4. C27 (0.1uF, bypassing pin 5 of U12) is incorrectly identified as C26
5. C31 (0.1uF, between Q7 and Q8) is not identified
6. R39 (180 ohms), is incorrectly identified as R38 and shown as 150 ohms
7. R34 (220 ohms) is incorrectly identified as R35
8. R38 (470 ohms) is incorrectly identified as R34
9. R33 has a value of 15k, not 33k as shown
10. R35 (1M) is incorrectly identified as R39

The parts list also has some errors:
11. R22 is shown twice; the correct value is 47 ohms
12. R39 should be shown with a value of 180 ohms
13. C15 and C16 should have a value of 4.7nF
14. C20 should have a value of 2.2uF
15. C29 should have a value of 22nF
16. U12 is not listed. It's a TL072/LF353

Also the schematics show C4 (2.2uF) on the output side of U10, whereas it's on the input side as shown on the PCB overlay. Similarly the supply for R13 and the tuning pot is taken from the 'source' side of R24, not the 'load' side as shown in the schematic.
Note that it may also be necessary to reduce the value of R22 with some units, to achieve a clean audio sinewave.
Our apologies for the above errors, and our thanks to reader Mr D.J. Cardwell of Guildford, NSW for pointing them out.

IR Remote Control Transmitter (September 1996):
Transistor Q1 (BC337) was shown reversed on the PCB overlay diagram. Either fit it with the C and E leads, or replace with a PN100 transistor fitted as per the overlay. Also R5 should be changed in value to 18k 1%, and R6 should be changed to 100 ohms. As the IR LEDs are quite directional in their emission, operation may be improved if the leads of the two LEDs are bent slightly so their beams converge at a distance of about three metres or so.

PLL Modules (January 1996):
There are a number of errors in the YAPLL-U schematic of Fig.4:
1. The correct value for C7 is 220pF, not 22pF
2. The correct value for C16 is 4.7nF, not 47nF
3. The correct value for C8 is 10nF, not 10uF

Also there are a number of incorrect component values in the PCB overlay diagrams of Figs.2 and 5 — please refer to the circuit diagrams for the correct component values. Note that the PCBs are double-sided, with a ground plane on the top.

We also inadvertently omitted to advise readers regarding the availability of the YAPLL modules. These are available from Tibor Bece at PO Box 1379, Sunnybank Hills 4109. Complete kits (excluding VCO modules) are $69 each, plus $5 for packing and postage. The PC boards are also available separately, priced at $25 each, and also the PLL ICs for $18 each.

Our apologies for these errors and omissions. The sample driver routines for use with the YAPLL modules are available on the EA Reader Service BBS, compressed in the file YAPLL.ZIP. ❖

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NEWS HIGHLIGHTS

BOSCH EXPANDING IN VICTORIA

In a move which will increase its annual exports from $40 million to more than $200 million within the next five years, and generate up to 1000 new jobs overall, automotive electrical and electronic equipment manufacturer Robert Bosch Australia has undertaken a major expansion of its manufacturing complex in Clayton, Victoria.

The expansion has been prompted by RBA being awarded global responsibility for the development, manufacture and marketing of car body electronics for the Bosch group, the world's largest independent manufacturer of automotive equipment. To handle the additional responsibility, the Australian arm of the company has invested $60 million in the new Clayton production facility. Car body electronics production will be housed in the new 60 x 200m facility, which was expected to be up and running last month (February 1997).

Components produced at the new plant will be exported primarily to customers in Europe, with a limited number ending up in the USA.

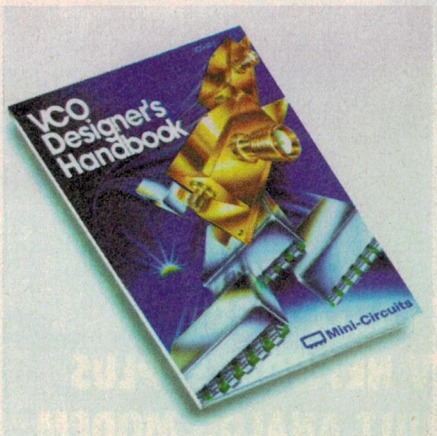
Dr Heiner Gutberlet, Director of Robert Bosch Gmbh in Germany, said the Australian plant was awarded global responsibility for car body electronics "based on its history of performance in development of these products, its superior capability for rapid and flexible application to meet customer requirements as well as its cost competitive manufacturing".

Robert Bosch Australia's automotive division already manufactured vehicle security systems, anti-lock braking systems, starter motors and alternators, climate control systems, body electronics modules, electronic fuel injection, engine management systems and electric engine cooling fan assemblies for local and overseas markets. The company has held global responsibility for the development, manufacturing and sales of vehicle security systems used in many of the world's cars since 1992.

Looking to the year 2005, the company plans to double its export turnover to more than $400 million — assuming its new product developments are well received by carmakers.

HANDBOOK FOR VCO DESIGNERS

Mini-Circuits has released a new 68-page *VCO Designer's Handbook*, loaded with information such as answers to frequently-asked VCO questions, a glossary of VCO terms, testing methods and practical 'hands on' application notes about reducing power supply and phase noise, PLL and synthesiser design, and much more.



The Handbook also contains the most complete and up-to-date specifications and price information about Mini-Circuits' range of plug-in, surface mount and connectorised VCO modules — including computer automated performance data (CAPD) for each model. It is written for designers and users, the inexperienced and very experienced alike.

To receive a free copy in the mail, contact the Australian distributor for Mini-Circuits, Clarke & Severn Electronics of Unit 4, 8A Kookaburra Road, Hornsby Heights (PO Box 1, Hornsby 2077); phone (02) 9482 1944 or fax (02) 9482 1309.

SOLAR & ADVANCED TECH BOAT CHALLENGE

Australia's second international solar and advanced technology boat race will take place on April 12 this year on Lake Burley Griffin in Canberra. The race will be the opening event of the 1997 Australian Science Festival, and is being promoted as the boating equivalent to the World Solar Challenge for cars.

ASF Director Mary-Anne Waldren said the Endurance Prize in each class is considered to be the most prestigious award given out on the day. Pizzeys Patent and Trade Mark Attorneys have awarded a prize of approximately $10,000 towards the cost of an International Patent Application for a new vessel judged the

most technically advanced or innovative. There would also be two school prizes, one for the best manufactured entry from the Canberra Region Advanced Technology Manufacturers Assocation and one from Philips for the best endurance result on the day.

Ms Walren said international renewable energy expert Hans Tholstrup would again act as race advisor.

According to Mr Tholstrup, solar and alternative energy powered boats have more immediate commercial prospects than solar cars. "The solar powered cars we race today are prototype formula one style cars which are a long way into the future for everyday use", he said. "The boats such as we saw on Lake Burley Griffin in 1995 have fewer building costs and have already proved their worth for quiet cruising around lakes and rivers, even the ocean."

EMONA TO HANDLE STAG PROGRAMMERS

Emona Instruments has been appointed by Stag Programmers Ltd of the UK to handle their range of device programmers. Stag is Europe's largest manufacturer of silicon device programmers, with a range of products suitable for industrial, commercial and military applications. Formed in 1974, the company's worldwide headquarters are based in the UK and houses Stag's R&D, manufacturing and service facilities.

Stag's products cover the full range of programming applications including low cost PC EPROM programming, compact, battery portable programming and emulation, high throughput production programming, universal programming, standalone or computer controlled CAE design tools and compilers. The company has product approval from all the major silicon manufacturers as well as approvals from the Ministry of Defence, US Department of Defence (QA500) and NATO. In addition, it has just obtained IS09000 quality system certification.

COMMS GEAR LEAVES FOR INDONESIA

The first export consignment in Philips Electronics $64 million Australian microwave telephone contract with Indonesia left Sydney on time in December. The first phase shipment includes four IRT-2000 systems which are to be installed in Sumatra for the Indonesian Telecommunication Operator, PT Telkom. Subsequent shipments are destined for Indonesia's eastern provinces including Irian Jaya, Maluka, Nusa Tenggara Barat, Timor

WORLD'S 'OLDEST COMPUTER' REASSEMBLED

The recent reassembly in Melbourne of CSIRAC, claimed as the world's oldest surviving complete programmable electronic computer, has sparked a major effort to document its history — and also gain international recognition for Australia's leading place in early computer history.

After gathering dust in a museum warehouse for many years, the seven tonne, 47-year-old CSIRAC (Council for Scientific and Industrial Research Automatic Computer) has been faithfully reassembled by the University of Melbourne's Department of Computer Science.

A 'dinosaur' from the first generation of electronic computing, CSIRAC was preserved intact (although never displayed) by the Museum of Victoria, unlike other early machines in the US and the UK which were mostly dismantled and scrapped.

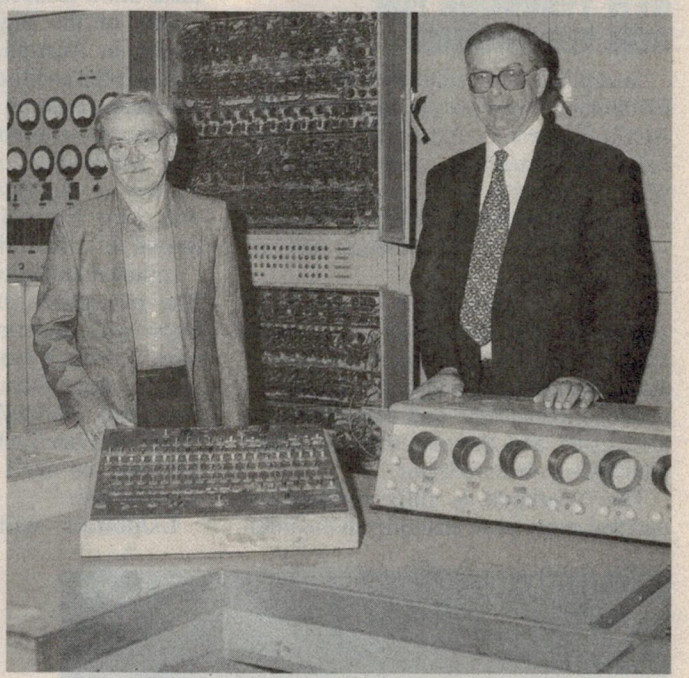
CSIRAC is now on display in its own laboratory — complete with the original laboratory door — at the computer science building, alongside today's multimedia laboratories and highpowered servers.

The Head of the Department, Professor Peter Thorne, said CSIRAC's resurrection had highlighted Australia's pioneering role in computer development. "This role has been largely ignored by overseas historians, and is not even particularly well known in Australia," Professor Thorne said.

"Since putting CSIRAC on display, we've started the task of collecting and collating as much historical material about it as we can, including taped interviews with the people who designed, built and worked on it, so the story can be put straight about what the pioneers in Australia achieved", he said.

"There is a blind spot about Australia in computer histories written in the northern hemisphere. If you look up historical accounts of computing on the Internet, for example, you'll find plenty of references to the early computers in the US and the UK, but not a mention of the fact that Australia developed the fifth programmable electronic computer in the world."

"This is a serious omission, and points in part I think to Australians being a bit too modest about their capacities and capabilities. Australia was the third country in the world, next to the US and the UK, to develop a modern computer and it did so in parallel with, but largely independent of, similar technological advances in the northern hemisphere."



Professor Thorne said CSIRAC, developed by Trevor Pearcey and Maston Beard at CSIRO's Division of Radiophysics in Sydney, was a unique and elegant design inspired by a psychological paper on the function of the human brain.

"To save power consumption and to increase reliability, it kept the number of vacuum tubes down to 2000, which was much less than similar machines of the time. It did this by using an ingenious memory system of mercury delay lines — devices developed for radar systems during World War II."

CSIRAC has been on display at the University of Melbourne since June last year, when its reassembly was celebrated by a two-day conference at which presentations were given by a number of the original CSIRAC scientists, engineers and users.

CSIRAC ran its first program in 1949. It was 7.6m long and 2.4m high, weighed seven tonnes and required 30kW of power. The total memory capacity was 2K bytes, and it performed only 1000 operations per second — about 100,000 times slower than a 486 PC.

and four others in Sulawesi.

The turnkey project involves the construction of twenty 110-metre transmission towers in 500 remote sites. Installation is to be completed within two years.

The IRT-2000 system is identical to the highly successful rural telephone system that Philips supplies to Telstra for use throughout outback Australia. The network is expected to provide access to over 11,000 direct telephone and ISDN capable lines. Some 15% of the lines are to be reserved for public pay phones.

Manufacturing and systems testing is undertaken at the Philips Manufacturing Centre at Moorebank in Sydney's west.

NEW YEARBOOK FOR ACEL ELECTRONICS

Australia's 10th edition of the ACEL Electronics Yearbook is now available. ACEL Electronics Yearbook 1997 provides full details on 'who's supplying what' in today's world of electronics in Australia. It tells you where — and how — you can access the products and services you need.

The book allows you to search by product to find a supplier or by brand name to find the local agent of an overseas or Australian company. Suppliers' catalogs, datasheets and data books are also listed and there is even a section identifying obscure logos.

The Yearbook is fully revised and updated every year, ensuring all the information is as accurate and current as possible. This year there are many more product headings, new suppliers, agency and address changes and more company profiles. Telstra has also made thousands of changes to Australia's phone and fax numbers, all of which feature in the new book.

More information is available from the ACEL Electronics Web site at www.acel.net.au.

SOUND & VISION SHOW IN MELBOURNE

Following its successful debut last year, the Herald-Sun Sound & Vision Show will be held at the Melbourne Exhibition Centre in conjunction with the HIA Home Ideas Show from April 4 - 6.

One of the biggest hifi exhibitions staged in Australia, this show enables audiophiles and the general public to see the very latest in home entertainment equipment available from manufacturers, wholesalers and distributors. All visitors to the HIA Home Ideas Show will gain free entry to the adjoining Sound & Vision Show and vice versa.

Initiated and sponsored by the *Herald Sun* newspaper, the Sound & Vision Show will showcase some of the biggest names. Among those participating in last year's show were Panasonic, Pioneer, Kenwood, Philips/Marantz, Sony, Scan Audio, Amber Technologies, Access and Yamaha as well as many specialist wholesalers.

Exhibitors will demonstrate their products at the show and many of the stands will include fully enclosed Audio/Demo rooms.

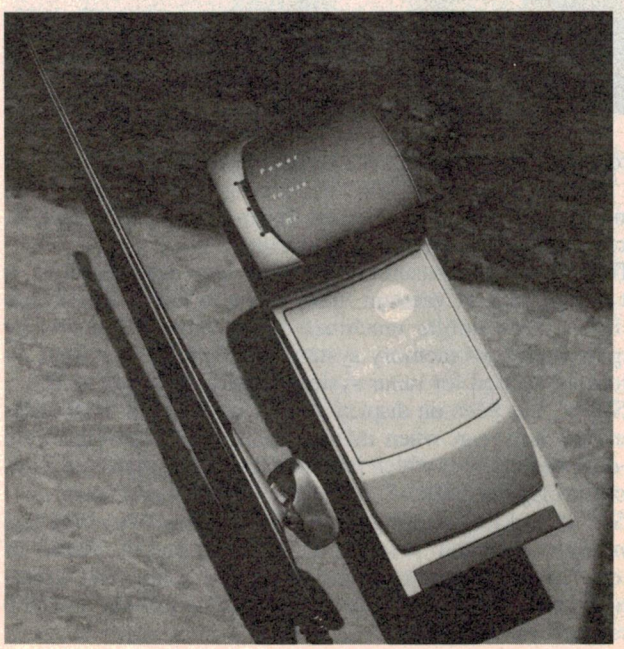
BOOST FROM CHINA'S NEW FABS, SAYS SEMI

Opportunities in China for semiconductor fabrication equipment makers will continue to grow over the next few years, according to the Semiconductor Equipment and Materials International (SEMI) trade association. This followed the recent close of its most successful conference and exposition in Beijing.

SEMI estimates the semiconductor equipment market will reach US$700 million by the end of 1997, driven by nine new fab investments planned for completion through the end of 1998.

The group of largely sub-micron labs currently planned in China includes joint ventures with such giant multinationals as Motorola, NEC and AT&T, Davis said. The factories will feature an estimated combined monthly output of more than 85,000 wafers per month.

Based in Mountain View, California, SEMI is an international trade association serving more than 1850 companies participating in the US$55 billion semiconductor and flat panel display equipment and materials markets. Founded in 1970 in the US, its primary goal is to help its members expand their global marketing opportunities and improve access to their customers and industry, government and civic leaders.



Swedish firm PC Card Distribution has released this GSM cellphone and modem combination in the form of a PCMCIA card which plugs directly into a portable PC. Called the V.Dot, its phone is controlled entirely from the PC. The modem uses the same transfer rate 9600b/s used for standard GSM telephony. The company's WWW site is at www.pccard.se.

AUST APPROVES SUN FIREWALL

Sun Microsystems has become the first company to gain Australian Government certification for its 'firewall' data communications security solution, SunScreen SPF-100G. The security solution is also the first firewall in the world to gain official government security certification.

SunScreen has been certified under the Information Technology Security Evaluation Criteria (ITSEC). ITSEC is a global security certification scheme, developed in Europe, that has been adopted by the Australian Government as part of its Australian Information Security Evaluation Programme (AISEP).

The AISEP is run by the Defence Signals Directorate (DSD), which acts as the National Computer Security Advisory Authority for the Australian Government. The SunScreen certifica-

tion is the first made under AISEP. "Most governments, including the Australian Government, are concerned about security and how much trust can be placed on security products", said Russell Bate, Sun Microsystems Australia's Managing Director.

"This concern is increasing with the rapid expansion of the Internet and the increasing number of departments and agencies wanting to connect to external networks. SunScreen offers them the security they demand and guards against all unauthorised access", said Bate.

SunScreen SPF-100G is a complete firewall solution which includes hardware, software, training, installation and configuration services, and expert technical support. The administrator can determine how packets are screened, which hosts are permitted network access and what types of access are permitted. The filter uses stateful, dynamic packet screening and works at the network (IP) layer. It is therefore transparent to users and has no effect on applications.

TAPE DUPLICATOR MOVING INTO DVD'S

Southern Star Duplitek, Australia's largest audio and video tape duplicator, is expanding its operations into CD, CD-ROM and DVD manufacturing with a new $12 million plant and a technical alliance with Pioneer Video Corporation, the world leader in optical disc technology.

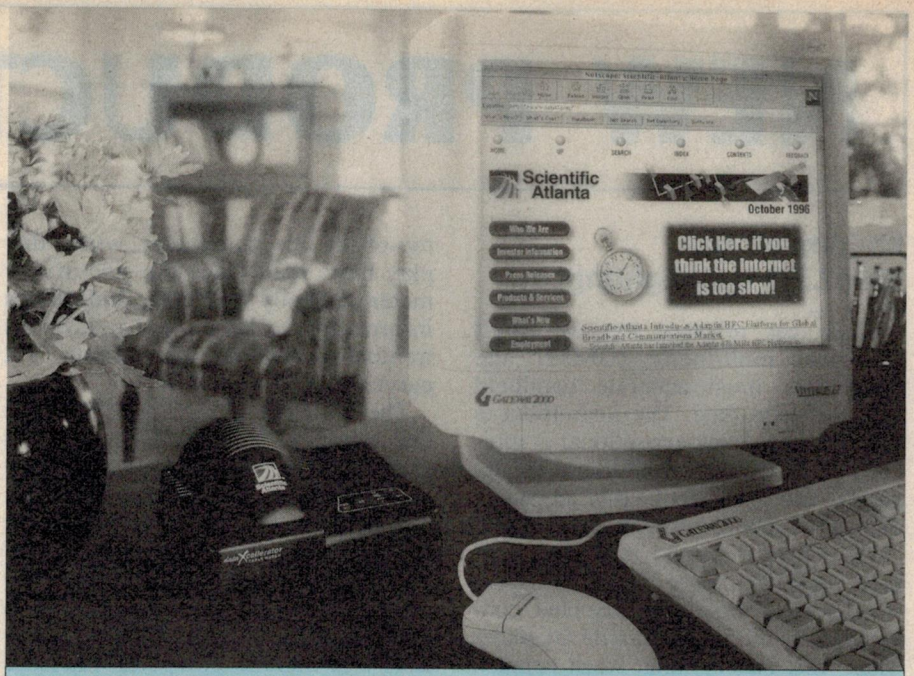
Duplitek is expanding its 5000 square metre headquarters in North Sydney by a further 2500m^2 to accommodate the plant, which will be installed by April and commissioned by July. The plant will manufacture conventional compact discs for the music industry, the computer industry and also video discs for the major Hollywood studios. The expansion is expected to create 30 jobs.

Dupitek is part of the Southern Star Group, and this expansion is the first major development since the company's successful float of September 26 last year.

The 'Phoenics' mastering system developed by Pioneer Video Corporation will be supplied by Marubeni Australia Ltd, together with two Marubeni Dual-Line systems consisting of Meiki moulding machines and an Origin spin-coater and finishing system.

DVD (digital video disc) is the next generation of CD technology, designed from the ground up to play full-length movies and provide high-capacity data storage.

"Southern Star Duplitek has spent two years investigating the feasibility of such a plant worldwide. We have closely with members of the international DVD Consortium and leaders in the development of DVD applications and equipment, to ensure we have kept up to date with the latest technology", said Mr Nigel Price, GM of Southern Star Duplitek. ❖



TEXAS CABLE CO TO TEST S-A CABLE MODEM

Scientific-Atlanta has announced a contract with a subsidiary of TCA Cable TV, Inc. under which TCA will test Scientific-Atlanta's 'dataXcellerator' cable modem. Upon successful completion of the trial, which was scheduled to begin in January, TCA has agreed to purchase a total of 20,000 units over a two-year period for use in its systems throughout Texas, Arkansas and Louisiana.

Scientific-Atlanta's dataXcellerator cable modem is designed to provide a cost-effective way for cable operators to deliver high-speed data services over their existing broadband networks. Most of the world's broadband cable networks only allow signals to travel in one direction — towards the home. The dataXcellerator cable modem uses the public telephone network and a built-in analog 28.8/33.6kb/s telephone modem to provide a return path. As a result, cable operators can offer high-speed data services without upgrading their networks to a two-way path.

The dataXcellerator cable modem, scheduled for production in the first quarter of 1997, was announced recently at unit prices ranging from US$199 to US$259 depending on quantity purchased.

TCA, headquartered in Tyler, Texas, is the 18th-largest cable system operator in the USA. It serves approximately 640,000 subscribers, primarily in Texas, Arkansas and Louisiana.

NEWS BRIEFS

- Papers on aspects of microelectronics are now being invited for presentation at ***Micro '97***, to be held 29 September to 1 October 1997 at the IBIS Hotel, Melbourne. For details contact The IREE Society (02) 9929 0099.
- ***ATTAR*** has moved to new offices at Unit 27, 134 Springvale Road, Springvale 3171. Postal address is PO Box 286, Springvale 3171, phone (03) 9574 6144, fax (03) 9574 6133. ATTAR are now agents for Magnaflux in Australia and New Zealand.
- The fourth ***Taipei International Electronics Spring Show*** will be staged at the Taipei World Trade Center Exhibition Hall from 28 March to 1 April, 1997.
- ***Oatley Electronics*** has moved to new premises. The new address is 66 Lorraine Street, Peakhurst, 2210, postal address (as before) is PO Box 89, Oatley 2223. Phone number is (02) 9584 3563, fax (02) 9584 3561.
- ***AIEE'97***, claimed to be Australia's largest engineering exhibition, will be held 20-23 May, 1997 at the Melbourne Exhibition Centre. Enquiries on (02) 9439 9329.
- ***Comcon Solutions*** has moved to new premises at Level 4 (from Level 15), 213 Miller Street, North Sydney 2060. Phone and fax numbers are unchanged. ❖

NEW PRODUCTS

Multimeter has blue LED backlighting

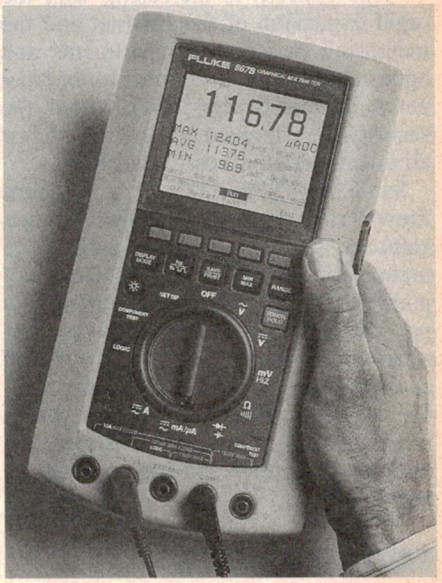
Fluke has released its new 867B graphical multimeter (GMM), the company's most accurate handheld multimeter to date. The instrument is claimed to provide exceptional graphical and reporting capabilities, on the largest and most technically advanced display available in today's market.

The meter's display uses new light emitting diodes from Nichia of Japan, which emit a broadband sky blue, converted to white backlight with an amber filter. This backlighting, when coupled with a transmissive liquid crystal display from Hitachi, is said to provide a higher contrast and a significantly brighter image than other displays. Another benefit is reduced power consumption, claimed to be less than half the power of backlights of similar intensity.

According to Fluke, the 867B is a top-of-the line multimeter with a display more than twice the size of any meter currently available, and allows information to be viewed quickly as trends, waveforms, component V-I curves or logic symbols.

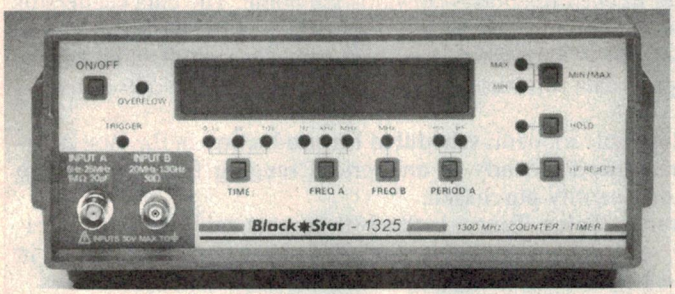
The multimeter has a 0.025% basic DC accuracy, which allows it to detect very small DC signal variations, especially in low-level transducers and analog electronics. Because the backlight runs from 5V DC, there is no AC-DC converter required, giving much 'quieter' readings. The instrument can also measure currents with a 10nA resolution. An inbuilt computer interface allows the meter to be used with an optional software kit to log readings to a PC. Continuous monitoring is possible through a trend graph feature that graphically represents a signal's performance over time.

For further information circle 241 on the reader service coupon or contact



Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

5Hz to 1.3GHz frequency counter



The new Black Star 1325 counter/timer measures frequencies and period from 5Hz to 1.3GHz. Designed and manufactured in Britain, the instrument uses a microprocessor controlled reciprocal measurement technique, said to give a fast response and high resolution at all frequencies. The meter features a large 8-digit LED display with good visibility in poor light conditions, and front panel indicators for all functions.

The frequency measurement ranges are accomplished over two inputs: 5Hz to 25MHz with an input impedance of 1MΩ and 20MHz to 1.3GHz with an input impedance of 50Ω. Maximum input voltage is quoted at 30V DC or AC peak. Period measurement is from 200ms to 40ns. Measurement gate times are O.1, 1.0 and lO seconds. The timebase runs at 10MHz with a stability of +/-1pmm. An optional TCXO gives a stability of +/-0.2ppm, a temperature coefficient of +/-1ppm and an ageing rate of less than 1ppm/year.

Other functions include a min/max mode, display hold and a high frequency reject filter. Complete control of all functions of the instrument is possible via the optionally available RS-232 interface. Another option is an external TTL clock input. The instrument can be powered from the mains or with six C size cells that give about 200 hours operation.

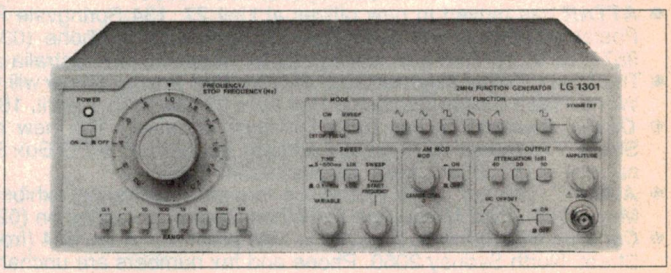
For further information circle 243 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 9698 4111.

Versatile 2MHz function generator

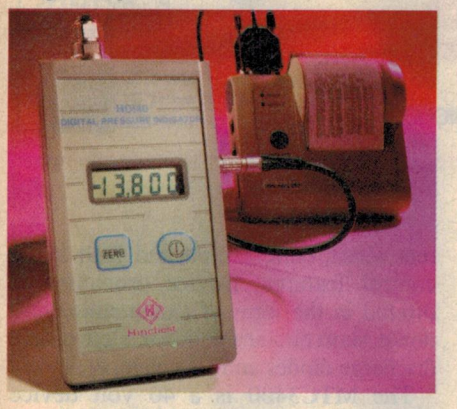
Leader Instruments has released its new function generator, model LG1301. The instrument has a frequency range from less than 0.002Hz to 2MHz and can generate sine, triangle, square, pulse, and sawtooth waveforms. The pulse waveform can be continuously varied in duty ratio from 1:9 to 9:1.

The unit also has sweep and AM modulation functions. The sweep function is adjustable and can be changed to linear or logarithmic. The AM modulation function can output DSB signals via a built in suppressed carrier function. FM signals can also be produced by use of an external frequency control. Other functions include synchronous/TTL output, DC offset, fixed and adjustable attenuators, and variable symmetry and amplitude.

For further information circle 249 on the reader service coupon or contact Stantron Australia, PO Box 4760, North Rocks 2151; phone (02) 9894 2377.



Digital pressure meter



The recently released HD140 digital pressure indicator from Hinchest is ISO9000 compliant and battery powered for on-site use. It has a full scale accuracy, including temperature compensation, of +/-0.05%, and a 4.5 digit display. It can measure pressures up to 600 bar gauge and up to 400 bar absolute.

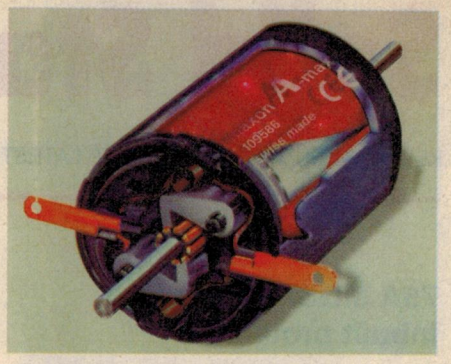
The meter can also store data in an internal memory, transfer the data via an RS-232 port to a PC or print it directly to an exclusive field printer. This system is said to simplify data handling in the field and creates computerised records for later reference. It also features automatic data logging, peak, valley and filter functions.

For further information circle 248 on the reader service coupon or contact Zenology Sales P/L, Suite 7, 1st Floor, 245 Springvale Road, Glen Waverley 3150; phone (03) 9802 0599.

Improved mini DC motors

Claimed to run longer than competitive DC motors, and to cost less, the new Maxon A-max range from Swiss engineering company Interelectric AG has a number of design changes. The housing is precision-made from rolled steel, giving increased strength. A redesigned commutator with a reduced diameter has an increased number of segments, said to give a longer operating life. The elimination of a C-clip groove has provided higher torsional stability and cross-sectional strength. A new winding technique has improved the performance relationship between the coil and magnet systems. Roll action springs on graphite brushes ensure a constant pressure over the motor's operating lifetime and allow a thinner brush cover, reducing space requirements.

Three, five or seven-fingered precious metal brushes can be specified for better contact, longer life and for minimising

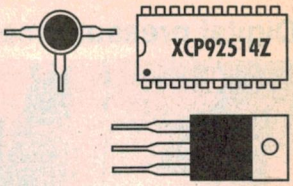


power consumption. Contact resistance is claimed to remain consistently low, even after long periods of inactivity. A cost-cutting hybrid manufacturing process forms the stator by assembling the motor housing, magnet and end cap in one step using injection moulding of polyphthalamide (PPA), a new US glass fibre-reinforced plastic which rivals metal in strength and stability. Either sleeve or ball bearings can be specified. Power leads or AMP-compatible terminals are available, with the outer cover providing stress relief for the leads.

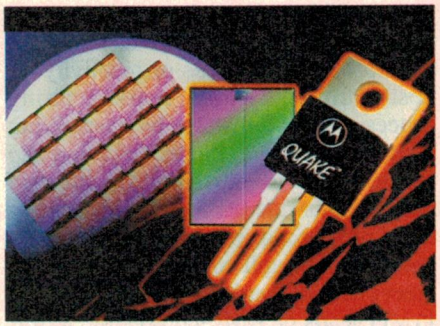
For further information circle 242 on the reader service coupon or contact M. Rutty & Co, 4 Beaumont Road, Mt Kuring-gai 2080; phone (02) 9457 2222. ❖

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



75A MOSFET has inbuilt protection



Motorola has announced the first product from its Quake family of integrated power MOSFETs. Targeted for industrial and automotive motor control applications, the MTC3400 Quake power MOSFET has an inbuilt temperature sensing diode, for use with analog sense and control circuits. This diode can be used to monitor the MOSFET temperature during high current events such as motor startup, motor lock, short circuit, and high current load peaks. This output can be used to regulate duty cycles to keep the MOSFET from failing because of over temperature.

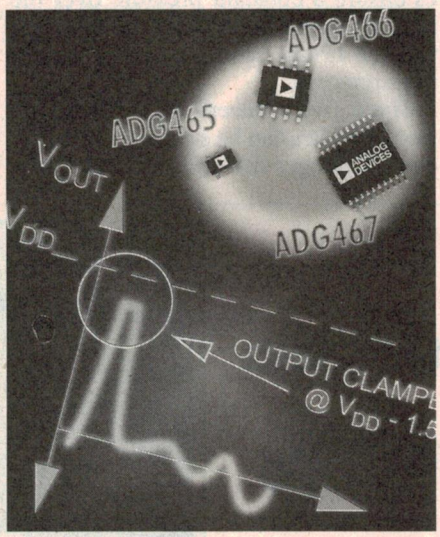
The MOSFET design also provides current sense, current limit and fault status control features. Device protection is offered in the form of temperature shutdown, short circuit shutdown, electrostatic discharge diodes and UIS clamps.

The MTC3400 is a 40 volt device with a current rating of 75A. It has a typical on-resistance of 5 milliohms at a Vgs of 10V. The product is a passivated die, but will fit into industry standard 3 or 5-pin T0-220 or D²PAK packages.

For further information circle 277 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

Circuit protectors with dielectric isolation

Analog Devices has announced the ADG46x family of dielectrically-isolated single, triple and octal channel protectors which provide automatic fault and overvoltage protection of downstream devices, whether power is on or off. The devices are claimed to be a world first, and use a patented protection system. The devices open an internal switch when the input voltage exceeds the limits of user-selectable supply rail voltages and can withstand continuous voltage inputs up to +/-35V. Applications include protection for ATE and sensitive measurement equipment.



The single-channel ADG465, triple-channel ADG466 and octal-channel ADG467 devices operate with both bipolar and unipolar supplies and feature an on-resistance of 50Ω (ADG465) and 100Ω (typical) for the ADG466 and ADG467. Input leakage current is specified at +/-500nA (maximum). Circuit latch-up during operation is eliminated by the design of the device.

The ADG465 comes in a space-saving 6-pin S0T-23, and the other devices are available in DIP, SOIC, uSOIC and SSOP packages. All devices operate over the standard industrial temperature range of -40 to +85°C.

For further information circle 272 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Stereo DAC has on-chip headphone amp

The new PCM1719 from Burr-Brown is a 16 or 18-bit stereo audio DAC with an on-chip headphone amplifier, a digital interpolation filter, a third order delta-sigma modulator and analog output amplifiers. It operates from a single +5V power supply and suits applications that require headphone drivers such as CD-ROM drives, DVD-ROM drives, digital audio workstations, and portable CD players.

The device accepts 16 or 18-bit I²S or normal data formats and includes an on-board 8X oversampling digital filter, as well as an analog low-pass filter. Other special functions include soft mute, digital attenuation (256 steps), digital de-emphasis, and L, R and mono output modes.

Specifications include -88dB THD+N, 96dB dynamic range and 100dB SNR. It is packaged in a very small 28-pin SSOP (fine lead pitch), and operates over the -25°/+85°C temperature range.

For further information circle 271 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

Dual axis +/-50g accelerometer IC

According to Analog Devices, the new ADXL150 and ADXL350 +/-50g accelerometer ICs are next generation devices that will give a reduced system cost and complexity while increasing performance and functionality. The ADXL250 is said to be the first fully integrated dual axis +/-50g accelerometer available commercially with signal conditioning on a single monolithic IC. The ADXL150 is a single axis version and also includes on-board signal conditioning.

The accelerometers are suited for vibration monitoring to spot mechanical problems, trigger preventative maintenance and diagnose the condition of rotating and oscillatory machinery. The company claims the widespread use of vibration monitoring has been limited by the high cost of sensors and signal conditioning equipment, which is overcome with these new devices.

The ICs use an 'open loop' architecture, meaning the force rebalance loop of the previous architecture has been removed and that the beam is allowed to flex during acceleration. The circuitry is much simpler than the 'closed-loop' architecture used with first generation devices like the ADXL50. Full clock signals are applied directly to the beams, increasing both the excitation signal level and the signal-to-noise ratio.

This technique also makes the product scale factor and bias level ratiometric to supply voltage and allows the power supply to be used as a voltage reference for the accelerometer and any analog to digital converter that follows. The new architecture has been tested to a billion total device flexures to confirm its stability and strength against wear and fatigue.

Typical SNR is 74dB at a 100Hz bandwidth, allowing resolution of signals as low as 10mg. Current consumption is 1.8mA per axis, and the devices operate from a single +5V supply. The sensitivity is 38mV/g. Both devices come in a 14-pin surface mount CERPAK package.

For further information circle 280 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Motor controller IC is DSP-based

Analog Devices is now sampling the first device in a new family of systems-level motor control ICs. Designated the ADMC330, the new device features a full set of motor control peripherals, a fixed point DSP (digital signal processor) and 4K of program memory augmented with specific motor control arithmetic functions. According to the company, the IC makes it possible to design an entire motor control signal chain with a single IC.

The functions of the IC are optimised for variable speed control of AC induction motors and electronically commutated synchronous motors. A three-phase, centre-based PWM controller generates programmable fixed-frequency, variable duty cycle waveforms for power inverter switching signals. The device also features an output enable block that simplifies space vector and sensor-less control algorithms, an external hardware trip/reset pin, and a pulsed output mode for transformer-coupled gate drivers.

Included in the device are a seven channel A/D converter, synchronised to the PWM switching frequency to minimise motor current ripple; two auxiliary PWM timers for power factor correction; set point control and low cost PWM/DAC capability; and an 8-bit digital I/O port for expansion capability.

The integration of the DSP core with memory and system peripherals provides quick response time to control loop changes without loss of precision, while also managing all analog loop functions.

For further information circle 274 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Frequency converter for transmit & receive

Harris Semiconductor has released the HFA3724 IC, claimed as the world's first monolithic IF/quadrature modulator/demodulator which converts between baseband and intermediate frequencies from 10 to 400MHz, in both receive and transmit directions.

The IF/QMODEM chip is said to simplify the design of a broad range of phase-shift keying (PSK) half-duplex wireless digital communications transceivers. These include wireless local area networks, time-division duplex quadrature modulated communications systems, time division multiplex access packet protocol radios, PCS/wireless PBX systems and personal handyphone systems (PHS).

Due to its power-management mode, the IC is suitable for use on PCMCIA cards and other portable applications such as wireless handsets. It is packaged in an 80-lead TQFP package and is priced at $23.95 (qty 10,000).

For further information circle 273 on the reader service coupon or contact B.B.S. Electronics Australia, Unit 24, 5-7 Anella Avenue, Castle Hill 2154; phone (02) 9894 5244.❖

Silicon Valley NEWSLETTER

Intel launches its new MMX Pentium chips

Intel has launched the first in its long-awaited MMX microprocessor family — chips the company hopes will take the consumer PC market by storm. A broad range of PC makers have announced the immediate availability of new machines based on the MMX Pentium chips.

The MMX's features enable computers to perform a number of multimedia tasks by the host processor, rather than peripheral boards. As a result, multimedia-intensive applications such as video-conferencing over standard telephone lines, software-based video and 3D graphics, and digital image editing and communications, will run up to 70% faster on MMX machines when compared with traditional Pentium systems.

The first MMX Pentium chips will run at 166 and 200MHz and cost US$407 and $550 respectively, in quantities of 1000 or more.

"The PC experience will be enhanced through a new wave of systems and software that provide such features as life-like colour, full-screen video and graphics, real-time animation and manipulation of images, 3D audio and dynamic lighting", said Mike Aymar, vice president of Intel's Desktop Products Group.

Compaq, Toshiba, Hewlett-Packard, Dell Computer, IBM, and Acer were among the first system houses to announce new PCs using the new chip. All are aimed at the home PC market.

Japanese boosting 64Mb DRAM production

With little or no chance of ever turning a decent profit in the 16-megabit generation of DRAM memory chips, producers are quickly shifting to 64Mb production. Japan's top five DRAM producers said their combined 64Mb chip outputs will increase 10-fold to about 7.5 million units a month by the end of this year.

The five firms — NEC, Toshiba, Hitachi, Fujitsu and Mitsubishi Electric — account for more than 40% of world DRAM production. NEC alone produced 500,000 of the DRAMs per month at the end of 1996. The firm hopes to increase that to between three and five million units a month. Toshiba, which currently makes about 100,000 units a month, will escalate DRAM output to one million by the end of the year.

Parallel supercomputer runs at 1.3 TeraFLOPS

Engineers at Intel's supercomputer facilities in Beaverton, Oregon have claimed title to the world record for computer processing speed, as the US$55 million massively parallel processing-based computer they are building for the US government achieved speeds in excess of 1.3 trillion mathematical calculations per second.

The machine, built around more than 9000 200MHz Pentium Pro chips, will be used by the US Energy Department to simulate nuclear test explosions, which are prohibited under current nuclear test ban treaties. In between such tests, the DoE will make the system available to other government and research organizations to test complex long-range weather forecasting techniques, genetic research, and space exploration programs.

How long Intel's 1-TeraFLOP record will stand is unclear, although it isn't likely to be very long. IBM, in cooperation with Silicon Graphics and its recently acquired Cray Research subsidiary, is reportedly close to finishing a 3TFLOP system.

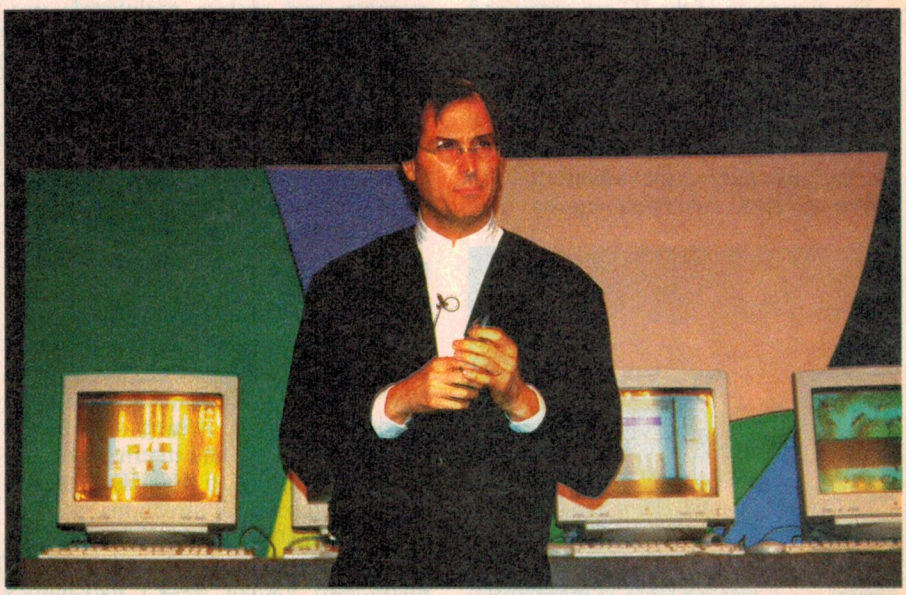
During the test run which Intel used to claim its speed record, the partially completed Intel machine, running on just over 7600 Pentium Pro chips, performed 6.4×10^{15} calculations during the one hour and 20 minutes test run. At this speed, the Intel machine accomplished in one minute what a 200MHz PC would take eight 24-hour days.

When the final 1400 Pentium Pro boards are installed, the computer will offer a constant processing speed of about 1.4TFLOPS.

"We are trying to show that with standard building blocks you can build absolute world class computers with record-breaking processing power", said Intel's COO Craig Barrett.

Japanese firms turn to microprocessors

Tired of their dependence on the volatile DRAM memory market, a consortium of major Japanese and European chipmakers have formed a consortium that will address the lucrative micro-



Not surprisingly, Steve Jobs was back on stage at the recent Macworld Expo in San Francisco, doing what he has always done best: singing the praises of Apple products — plus, of course, his newly acquired NeXT operating system...

processor market with a new generation of advanced microprocessors, combining memory and logic functions onto a single chip. The processors could end up running PC, consumer and business products representing hundreds of billions of dollars worth of annual worldwide sales.

The group of companies include Fujitsu, Toshiba, Matsushita, NEC, Hitachi, Mitsubishi, Sony, and Fuji Xerox. Europe's SGS Thomson Microelectronics and Texas Instruments' Japanese semiconductor subsidiary are also participants.

While the effort does not appear to be intended as a direct competitive threat to Intel's lock on the PC microprocessor market, analysts believe the group will compete with Intel and other US microprocessor firms in PC related markets such as multimedia board, peripherals, and other electronic products markets that currently use separate microprocessor and memory chips.

Representatives for the group said the chips will operate at more than twice the speed of today's leading-edge PC microprocessors. Specifications are supposed to be set within 12 months.

Considering the speed with which successive processor generations enter the market, the consortium's chips may run at only about half the speed of what will be mainstream processors around mid-1998.

Some analysts believe the Japanese firms will try to compete directly with Intel, as they desperately seek to re-establish control over the fast-growing Japanese PC market.

Apple buys NeXT, Steve Jobs returns as hypemaster

Apple Computer has put up US$400 million to buy NeXT, the company run by Apple co-founder Steve Jobs. The legendary 'master of hype' has returned to Apple nine years after Apple's board fired him, in the midst a bitter power struggle between Jobs and John Sculley.

Apple will pay US$350 million for NeXT, mostly in cash and some stock, and will also pay off $50 million in NeXT debts.

The move sent shockwaves through Apple, Silicon Valley and much of the computer industry — which is now waiting with baited breath to see whether Jobs will be able to help Apple chairman Gilbert Amelio return Apple to its former glory days as the innovation leader in the US$150 billion personal computer industry.

The announcement deals a huge setback to Jean-Louis Gassee, the former number two man at Apple, whose Be Inc. company had been negotiating with Apple for the past three months. According to Apple, Gassee had demanded US$400 million for its unproven multimedia-based operating system, far more than the $120 million Apple initially offered. Apple went as high as $200M, but Gassee refused. Only after he learned Apple was close to a deal with NeXT did he offer a lower price of $210M — but too late.

Apple's first big step will be to quickly replace its aging System 7 operating system with new software that will be based on NeXT's Openstep operating system. Amelio said he expects Apple to launch a NeXT-based operating system in 1997.

Asked what convinced him to return to the company that so bluntly booted him out in 1985, Jobs responded, "The Mac has provided the innovation that the industry has been feeding off for the last 10 years. It's time for someone to come up with innovation to drive the industry forward. Who better than Apple?"

Rather than a high-level full time position, Jobs will officially serve as advisor to the chairman. "I feel very lucky to be a part-time Apple employee and work for Gil and advise him on product strategy", Jobs said.

In his new position, Jobs will oversee the conversion of his operating system into the future Mac operating system, and to once again become Apple's chief public spokesperson in the company's effort to regain the recognition as a technology leader it needs to survive in the market.

To explain why Jobs decided to return to Apple, the company he cursed repeatedly for much of the past 11 years, close associates at NeXT say Jobs still has an intense love for the Macintosh he created, combined with a deep-rooted hatred of Bill Gates and Microsoft and their 'good enough' policy of product development.

With Apple, Jobs will not only achieve the satisfaction of having his operating system drive the personal computer industry forward, he will also be able to project himself once again as the PC industry's visionary. And apparently with Amelio's blessing. Although a proven manager, Amelio, like his predecessor Michael Spindler lacks the public charisma of either Jobs or Sculley. Apple, however, has always depended on the industry leadership of its top executives to keep the company in the spotlight.

Hitachi-LG DRAM joint fab cancelled

The crisis in the DRAM memory market has caused another major fab construction project to be cancelled. Hitachi announced that construction of a 16- and 64-megabit DRAM fab to be built in Malaysia as part of a joint venture with Korea's LG Semicon has been postponed indefinitely.

After a brief upturn, DRAM prices are once again heading south due to slower consumer demand for PCs in the fourth quarter of 1996. Many PC manufacturers had started to rebuild their DRAM inventories on forecasts of a strong fourth quarter sales to consumer and corporate sectors, but consumers in the US and elsewhere spent most of their holiday dollars in areas other than electronics.

The Hitachi move came after Toshiba shelved a 64-megabit DRAM joint fab project with Motorola in Northern Japan. NEC also recently cancelled a 64- and 256-megabit fab program in California.

Judge rules encryption controls unconstitutional

A US federal judge has dealt a potentially serious blow to US government attempts to keep advanced data encryption technology out of the hands of hostile governments, foreign terrorists and organized crime syndicates.

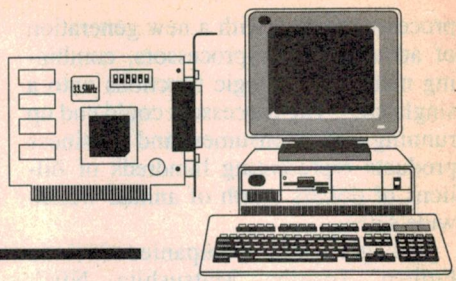
US District Court Judge Marilyn Patel ruled that the government has no right to prevent an Illinois maths professor from selling his encryption technology outside the United States. Patel said software code is protected under the Free Speech Amendment of the US Constitution and the professor, Daniel Bernstein, can therefore not be forced to adhere to unconstitutional government licensing regulations.

The ruling was hailed by civil libertarians and computer and software industry executives, who have seen a lot of their business lost to foreign competitors because they could not obtain export licences for products featuring advanced data protection technologies.

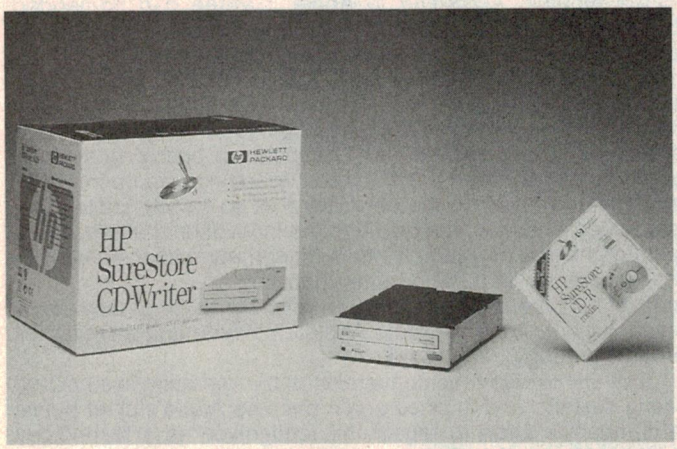
At RSA Data Security, the company that developed the public key encryption technology, company president Jim Bidzos said "This is the first rational ruling to come out of the government on export control that I have seen. It has been very frustrating to watch foreign competitors exploit the opportunity created by export controls."

Bernstein put himself at the centre of the encryption battle in 1992 when he asked the State Department whether the 'Shuffle' encryption program he created as a graduate student at the University of California at Berkeley would be covered under export control regulations. When the government said it was, Bernstein filed suit on the ground that the government was violating his constitutionally-guaranteed rights to free speech. ❖

Computer News and New Products



CD recorders with x6 speed



Hewlett-Packard has added three new CD-recordable (CD-R) products to its lineup of HP SureStore CD-Writers. The SureStore CD-Writer 6020 family includes units with internal and external SCSI, or parallel port interfaces that feature a x6 read speed and a x2 write speed. The 6020es is a SCSI version and the 6020ep is a parallel port version.

The units are said to be easy to install, and comprise a compact drive, a suite of software, interface cable, audio cable, one blank CD-R disc, installation diskette and instruction manuals. They have a 650MB capacity and are compatible with Windows 3.1, Windows 95 and Windows for Workgroups. The supplied software is claimed to allow even a computer novice to create CD recordings.

Programs included in the suite are Easy-CD Pro/Audio and Alchemy for Windows 95. Easy-CD Pro/Audio extends the Windows file manager for file transfer to the CD and allows users to prepare custom audio discs. Alchemy for Windows 95 allows users to create and search custom databases (includes a run-time search engine for use on any PC with a CD-ROM drive).

According to HP, many organisations are using CDs to organise, distribute and transport large files; archive information permanently; create custom audio CDs; and as output devices for multimedia files such as presentations, training and documentation. Prices for the units are $999 (6020i) and $1416 (6020es/ep), including sales tax, and are covered by a one-year limited warranty.

For further information phone the HP Customer Information Centre on 131 347. Information about HP products is on the World Wide Web at http://www.hp.com.

270Mb/s serial digital video

IRT Electronics has released four new products for the 270Mb/sec serial digital video market. The first of these is a 1300nm LED transmitter (DVT-3220) and PIN photodiode receiver (DVR-3220). These devices are designed for use with 270Mb/s SMPTE/EBU serial digital video using a 62.5/125 multimode fibre optic transmission link up to 2km in length. The transmitter features automatic cable equalisation for Belden 8281 coaxial cable and the receiver features reclocking circuits with automatic data rate selection of 143Mb/s, 177Mb/s, 270Mb/s and 360Mb/s to provide four serial digital outputs.

The second product is a matching laser transmitter (DVT-3210) and receiver (DVR-3210) that allow a standard SMPTE 259M SDI signal to be transmitted over distances of around 40km. This product is claimed to be ideal for those already using short-haul analog video and audio optical links to upgrade to 270Mb/s SDI operation.

Next is the DVC-3111, an encoder for converting SMPTE 259M 270Mb/s serial video to composite PAL or NTSC video signals. This device has one RGB (sync on green) and four reclocked 270Mb/s SDI outputs, as well as three composite video outputs that can be optioned to provide a single Y/C and one composite video output. Front panel indicators show loss of carrier and PAL or NTSC format.

The fourth product is the DAX-3200 module, which extracts AES/EBU synchronous 48kHz embedded audio from a 270Mb/s serial digital video signal, providing a digital and an analog output. A front panel rotary switch selects which one of the eight possible stereo AES/EBU audio channels is extracted. An AES/EBU 75Ω unbalanced, a 110Ω balanced and a broadcast quality 20-bit D/A balanced stereo output are provided in addition to two reclocked 270Mb/s SDI outputs.

The extractor can be used to provide an AES/EBU digital stereo audio channel for production purposes, while simultaneously providing analog audio monitoring of this channel. The IRT standard 3RU and IRU Eurocard frames can be used for all the above modules.

For further information circle 160 on the reader service coupon or contact LRT Electronics, 26 Hotham Parade, Artarmon 2064; phone (02) 9439 3744.

CPU card with video and SCSI interfaces

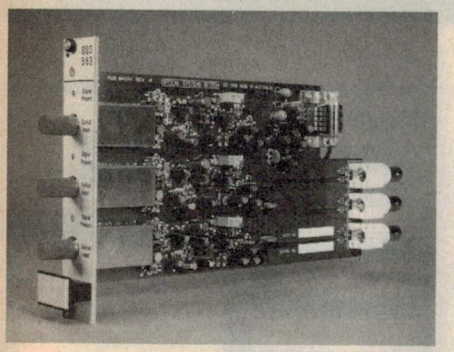
The AP-5200VF/VFS full-size CPU card, from Intelligent Systems Australia, has the latest Intel Triton 82430VX PCI chipset, a six-layer printed circuit board and low power consumption CMOS technology. It is claimed to be ideal for harsh industrial environments.

The card has built-in VGA and other enhanced I/O interfaces and can simultaneously drive CRT and flat panel displays. It also includes an ultra-wide SCSI controller, a double speed SCSI-3 bus controller and a PCI 32-bit bus master with zero wait state transfer capability.

There are also two enhanced FIFO 16550 serial ports, one of which is selectable for RS232/422/485, a high performance multi-mode parallel port, two PCI IDE interfaces for up to four IDE devices and one floppy disk drive controller.

For further information circle 161 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone (03) 9796 2290. Internet site at **http://www. intelsys.com.au**.

Triple video modem cards



Optical Systems Design has announced its OSD551/OSD553 triple video modem cards, designed for high performance surveillance systems for use in industrial monitoring, medical imaging, multiple video trunks and large CCTV systems with many tie lines or remote cameras.

The cards have three transmitters and three receivers, a 10MHz bandwidth, and support wideband video transmission over 5km (or more) lengths of optical fibre. Benefits available from these cards include greater security than coaxial cable, complete end-to-end isolation and higher quality compared with using coax or twisted pair cables. They also provide a higher modem density in a 19" rack mounting configuration. The modem cards are compatible with most of OSD's other video transmitter and receiver products.

For further information circle 162 on the reader service coupon or contact Optical Systems Design P/L, Unit 7, 1 Vuko Place, Warriewood 2102; phone (02) 9913 8540.

Software for robot kit

Procon Technology has released Windows software for controlling Fischertechnik robotic kits. Complete source code is provided on the disk for VisualBASIC for Windows version 3 or greater. The supplied routines can also be used by other Windows-based languages to control motors, switches, lamps, electromagnets and buzzers in response to changes in light, temperature or motion, as detected by sensors. The software is claimed to be ideal for children or adults at home or at school who want to learn about computer programming in automation and control.

The Fischertechnik interface unit provides eight digital inputs, two analog inputs and four bi-directional motor outputs. The unit connects to any IBM-PC parallel printer port and

allows a second unit to be attached for a total of 16 digital inputs and eight motor outputs (or 16 lamp/relay outputs). The analog inputs can be used with potentiometers (for position control), light dependent resistors, thermistors or other resistive devices.

Windows-based programs are provided with the Fischertechnik Profi Computing kit which includes three motors and gearboxes, six microswitches, four lamps, two light detectors, a temperature sensor, a 20-pin connection socket and a construction base-plate.

The Windows Robotics software costs $99, the interface unit (p/n 30566) is priced at $169 and the Profi computing kit (p/n 30330) costs $599 complete with software, interface and power supply.

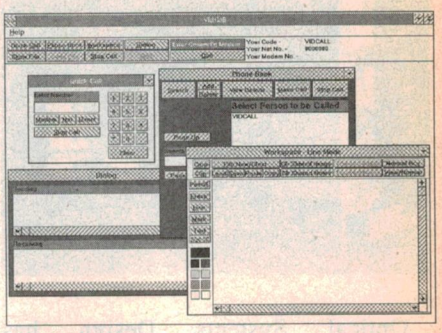
For further information circle 163 on the reader service coupon or contact Procon Technology, PO Box 655, Mount Waverley 3149; phone (03) 9807 5660.

Video conferencing software

VidCall is computer software that is claimed to be a revolutionary approach to video/voice and document conferencing. It allows the user to participate in shared workspace activities, and also see live, scalable video images of others working on the same project. It can incorporate live-action, colour video and voice with shared workspace over ordinary telephone lines (POTS) and the Internet. VidCall is said to have offered the first practical way to transmit live colour video and voice over the Internet.

The program can be used with most inexpensive video capture boards (including digital plug-and-play cameras) to transmit still and motion video. It does not need any hardware to receive and display video. A virtual motion of up to 10 frames per second can be achieved, depending on the computer, modem, VGA display and the operating environment (POTS, Internet, LAN/WAN). Higher frame rates are possible over a network. Half duplex voice over POTS and the Internet is supported with a standard sound card and 28.8kbps modem.

VidCall includes many editing tools and can bring a range of image file types into the workspace for transfer or shared annotation. Participants can also transfer the contents of the Windows clipboard. Multi-point video and document conferencing with up to 10 participants is available over a LAN/WAN. Applications for the software include



point-to-point and group conferencing, telecommuting, training, distance learning, telemedicine, product marketing, security/surveillance.

For further information circle 164 on the reader service coupon or contact A. Class Enterprises, 42 Cropley Drive, Baulkham Hills 2153; phone (02) 9639 6969.

Image acquisition board and software

National Instruments has announced the IMAQ PCI-1408, the company's first image acquisition board for PCI-based Windows 95/NT PCs. The monochrome card works with several video standards. The company has also announced its IMAQ Vision software for image acquisition, processing and analysis, and its NI-IMAQ driver software.

The image acquisition software has more than 400 functions for histograms, 3-D analysis, morphology and contrasting, and works with LabView, BridgeView, and LabWindows/CVI virtual instrumentation software. It is comprised of imaging software technology acquired from Graftek (Mirmande, France) in August 1996.

The new hardware and software products integrate with National Instruments

data acquisition (DAQ), VXI, GPIB and RS-232 products. National claim that the products allow users to build comprehensive industrial applications, such as on-line inspection and gauging, real-time process control, assembly verification, part counting and sorting, component alignment, wafer inspection and bar code reading. The products are also suitable for a wide variety of test applications, such as movement measurements, event recording and result verification.

For further information circle 166 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. (Website at **http://www.natinst.com/**). ❖

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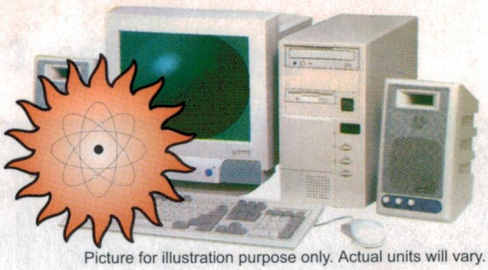

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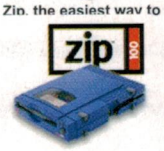

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